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CONTENTS

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICE—
Annual Meeting, American Gas Light Association..... 485
EDITORIALS—
Briefly Told..... 486
The Niagara Meeting—Retirement of Doctor Amory—Notes.
Fixation of Atmospheric Nitrogen, by Mr. W. Bouldin, Jr..... 487
Introduction of Incandescent Gas Burners for Public Illumination at Paris..... 487
The Chemical Composition and Technical Analysis of Water Gas, by Mr. E. H. Earnshaw..... 488
Ohio Coal Production in 1897..... 490
Mechanical and Economical Problems of the Coal Question..... 491
Specialism in Engineering..... 493
Pneumatic Riveters for Tank Work..... 494
Artificial Vanillin and Vanilla Flavors..... 494
Lubricants for Glass Stopcocks..... 494
ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 495
Mr. Somerville Calls Attention to a Misprint—Contract for the Berlin Iron Bridge Company—The Municipality to Operate the Galt (Ont.) Works—Mr. Miller Leases the Shippensburg (Pa.) Works—A Hint from Chicago—Charter for the New City Gas Company, Staunton, Va.—Death of Mr. Gideon Fordham—Mr. C. E. White Takes Charge at Wakefield, Mass.—Welsbach Lamps for Public Lighting—Annual Meeting, Lewiston, Me.—An Opinion from the Trenton (N.J.) *Gazette*—Mr. Eichbaum's Interesting Remarks—The Status of the Gas Supply of Memphis, Tenn.—And Other Items.
The Market for Gas Securities..... 497

[OFFICIAL NOTICE.]

Annual Meeting, American Gas Light Association.

OFFICE OF THE SECRETARY, MONTCLAIR, N. J., Sept. 6, 1898.

There will be an annual meeting of the American Gas Light Association held at Niagara Falls, N. Y., on Oct. 19, 20 and 21, 1898.

The meeting will be called to order by the President, Joseph B. Crockett, of San Francisco, Cal., at 10 A.M., on Wednesday, Oct. 19, in the meeting hall at the International Hotel, the headquarters.

The most satisfactory quarters are always obtained by writing in advance to the hotel people, and in doing so a reply should be requested, for which a self-addressed, stamped envelope should be inclosed, as misunderstandings may thereby be averted.

The International Hotel is conducted on the American plan, and rates are as follows:

Large parlors on first floor, $3.50 per day; all rooms on second and third floors, $3 per day; rooms with bath, $4 per day. At that season of the year we will be able to have the whole house.

The meeting hall will be on the parlor floor of the International Hotel; thus the headquarters and hall will be in the same building.

The roll call will be made by means of the door card system. Each member upon entering the hall for the first time will at the door receive a special card upon which he will find his name, address, etc., as it appears on the Secretary's books, and such card should be corrected and given to the doorkeeper. Members in attendance should attend to this very carefully, as these cards are used immediately after the meeting for correcting the annual membership list. Visitors will please hand to the doorkeeper their personal cards.

A blank form of application for membership accompanies this circular. More can be obtained of the Secretary.

Remember, all applications must be in the Secretary's hands by Oct. 9, at the very latest, otherwise they will not be acted upon at this meeting.

The list of papers to be read at the meeting is as follows:

"The Effect of the Depth of Fire upon the Practical Efficiency of a Water Gas Generator," by Mr. J. M. Rusby, Jersey City, N. J.

"Notes on Mains and Main Laying," by Mr. Walton Forstall, Philadelphia, Pa.

"The Loss of Illuminating Power of 25 to 30-Candle Gas when Mixed with Air," by Dr. E. G. Love, New York city.

Another paper is promised, the title and authorship of same to be announced later on.

In addition to the above there will be short topics by Mr. H. L. Doherty, Madison, Wis., Mr. E. G. Cowdery, Milwaukee, Wis., Mr. H. L. Rice, Norfolk, Va., and Mr. Irvin Butterworth, Columbus, O.

In accordance with the action taken by the Council and the Association last year, the Beal Medal will be awarded to the author of the best paper presented at this meeting; the question of which is best to be decided by a committee of three past-Presidents, appointed by the President.

All questions for the Question Box should be sent to the Secretary as soon as possible, in order that they may be printed in the next circular before the meeting, thereby insuring their discussion.

During the days of the meeting all announcements will be posted on the bulletin board in the meeting room. All members are warned to take notice thereof accordingly.

All members attending the meeting are particularly requested wear to their membership badges in plain sight, thereby greatly aiding the officers of the local committee in their work by affording a ready means of recognition.

In order that the Year-book containing the report of this meeting may be published and issued to the members immediately after the meeting—

Notice is hereby given, that if any of the speakers at this meeting desire to correct their remarks before they are printed, they will be given an opportunity before leaving Niagara Falls, but not after. The stenographer will have typewritten copy of the principal discussions prepared at the headquarters between the sessions of the meeting, and all those who desire to correct their remarks must notify the Secretary at the close of the session at which such remarks are made, as all the reports will be turned in to the printer immediately after the adjournment of the meeting.

Special rates for transportation have been granted (viz., full fare going and one third fare returning by the same route) by the several passenger associations named and under the conditions noted :

The Trunk Line Passenger Committee, covering the territory west of New England and east of Niagara Falls, Buffalo and Salamanca, N.Y.; Pittsburg, Pa.; Bellaire, O.; Wheeling, Parkersburg and Charleston, W. Va.

The New England Passenger Association, covering nearly all of the lines in the New England States.

The Central Passenger Association, covering the territory bounded on the east by Pittsburg, Salamanca, Buffalo and Toronto; on the north by the line of and including points on the Grand Trunk Railway from Toronto to Port Huron, thence via Lakes Huron and Michigan to the north line of Cook county, Illinois ; on the west by the west line of Cook county and the Illinois and Mississippi rivers, to Cairo, including Burlington, Keokuk, Quincy, Hannibal and St. Louis ; and on the south by the Ohio river, including points on either side of that river.

The Southeastern Passenger Association, covering the territory south and west of the Virginias and south and east of the Ohio and Mississippi rivers, and the Western Passenger Association, covering the territory west of and not including Chicago, Peoria and St. Louis, in other words, the territory west of that of the Central Association, have refused to grant the rates. Members from these territories should buy tickets from starting point to the nearest or most convenient point in the territory of any of the Associations granting the reduced rates, and at such point purchase tickets through to Niagara Falls and obtain a certificate.

The following extracts from the regulations of the railroads are cited for the information of the members. The special rates are granted subject to these regulations :

First. The reduction is conditional on there being an attendance at the meeting of not less than 100 persons holding certificates.

Second. Each person to obtain the excursion rate must purchase a first-class ticket (either limited or unlimited) to the place of meeting, for which he will pay regular fare, and upon request the ticket agent will issue a printed certificate of purchase of the standard form. Agents at all important stations are supplied with certificates.

Third. If through tickets cannot be procured at the starting point, purchase short-trip ticket to the most convenient point where such through ticket can be obtained, and there purchase through to place of meeting, requesting a certificate from the ticket agent at the point where each purchase is made.

Fourth. Tickets for the return journey will be sold by the ticket agent at the place of meeting at one-third the highest limited fare only to those holding certificates, signed by the ticket agent at point where through ticket to place of meeting was purchased, and countersigned by signature written in ink by the Secretary of the Association, certifying that the holder has been in regular attendance at the meeting.

Fifth. No reduction of fare will be made on the return passage if the going ticket is purchased more than three days before the opening date of the meeting ; except that when meetings are held at distant points to which the authorized limit is greater than three days, tickets may be purchased before the meeting in accordance with the limits shown in regular tariffs.

Sixth. Certificates are not transferable, and return tickets secured upon certificates are not transferable. The transfer of any such is liable to prevent the securing of reduced rates for future meetings.

Seventh. The certificate of agent at starting point, duly endorsed by Secretary of Association, must be presented to ticket agent at place of meeting, within three days (Sunday not reckoned) after adjournment of meeting. The return ticket will be for the line or lines covered by the going ticket.

Eighth. No refund of fare will be made on account of any person failing to obtain a certificate.

Special.

If a sufficient number of subscriptions are obtained, the social programme will be as follows : Wednesday evening, reception and hop ; Thursday evening, banquet to which ladies will be admitted on equal footing with the gentlemen ; Friday evening, informal hop ; Wednesday and Thursday, carriage drives for the ladies ; Friday, visit the Niagara Falls power house and other places of interest, and trolley ride down Gorge Route to Lewiston and return.

Tickets admitting members and friends to these entertainments can be had for $5 each. If you wish to join in them please sign inclosed card and return to the Secretary at once. It will be necessary to have at least 100 subscriptions.

Be sure to obtain your railroad certificate when buying your ticket for Niagara Falls, as the greater the number of certificates handed in, the easier it is to get the reduction in rates for future meetings.

Apply for tickets and certificates at least 30 minutes before train time.

Each person must sign his own certificate at time of purchasing for Niagara Falls.

Be sure to hand the Secretary your certificate as soon as you reach the headquarters.

Apply for return ticket at least 30 minutes before train time, and have your certificate with you.

Any person, ladies included, attending the meeting, is entitled to the reduced rate from the territories named.

Members will please hand their certificates to the Secretary, or his clerk, upon arrival at place of meeting. If there are 100 members present, holding certificates, each certificate will then be properly indorsed and handed back to owner, before adjournment.

Extracts from the Constitution.

Sec. 12. Application for active membership, or for associate membership, or for transfer from associate to active membership, must be received by the Secretary at least 10 days prior to the meeting at which the application is acted on.

Sec. 51. No member who owes two years' dues shall be entitled to vote, or to participate in the deliberations of the Association, or to receive a copy of the proceedings.

Sec. 52. Any member whose dues shall remain unpaid for a term of three years may be dropped from the roll of membership by a vote of the Council.

ALFRED E. FORSTALL, Secretary.

BRIEFLY TOLD.

THE NIAGARA MEETING.—The outlook for the Niagara Falls meeting of the American Gas Light Association is of an order sufficiently assuring that those who attend it shall be well repaid for all expenditure of time and money involved in making the necessary journeys between their homes and the convention place. Secretary Forstall's official notice shows but little change this week, the main amendment being the elimination of the name of Mr. E. C. Jones, Engineer of the San Francisco Gas Light Company, from the list of the promisers of papers. Mr. Jones is known for his thoroughness, and as the time just now at his disposal is not equal to that necessary for the proper preparation of the theme which he had in mind, he preferred, rather than compile indifferently, to postpone to another season his paper. Such postponement, too, can be accepted by the members with good grace, since his chief (Mr. Joseph B. Crockett), as President of the Association, is down in the natural order of things to be on hand with an inaugural address. Other shifts in the notice show that Messrs. Butterworth and Rice will present short topics for discussion, rather than hand in set papers ; but the set list is to be increased by a paper, the authorship and title of same to be made known later on. The local committee of arrangements have been unremitting in their studies of how to care for their guests, during the hours of ease in the sessions, and the programme they have evolved is certain to be thoroughly enjoyed by all.

RETIREMENT OF DOCTOR AMORY.—With regret we report the retirement from the service of the Brookline (Mass.) Gas Light Company, of its President and Manager, Doctor Robert Amory, who closed his connection with the Company Wednesday last. Since 1882 Doctor Amory managed the Company's affairs wisely and well, an assertion on our part that seems quite if not altogether superfluous, for its upholding and amplification are to be found by mere reference to the annual reports of the Massachusetts Board of Gas and Electric Light Commissioners. Doctor Amory proposes to enjoy that rest which is the portion of those who labored well and carefully, and our earnest hope is that time without stint is before him.

NOTES.—Mr. Charles L. Gerould, First Lieutenant of the 47th New York Infantry, has been honorably discharged from the military service of the United States. In other words, Mr. Gerould is again in harness, managing the affairs of the American Gas Company's works at Mount Vernon, N. Y.——We understand that the American Gas Company has disposed of its electric property at Portchester, N. Y., to local capitalists——The proprietors of the Atlantic City (N. J.) Gas and Water Company have determined to make important main extensions. At a special meeting of the Directors, held the last week in September, appropriate resolutions to the memory of the Company's late President (Mr. Joseph A. Barstow) were adopted. Mr. J. H. Lippincott was elected to the vacancy on the Board, and the following executive management was named : President, Mr. Joseph Borton ; Treasurer, Dr. Thomas R. Reed; Secretary and General Manager, John P. Tompkins. ——Mr. Edward J. Elles, formerly Assistant Superintendent of the Detroit City Gas Company, has accepted the position of Superintendent to the Macon (Ga.) Gas and Water Company.

[Communicated Article.]

Fixation of Atmospheric Nitrogen.

By Mr. William Bouldin, Jr.

The recent address by Professor Crookes before the British Association, especially that part of it wherein he referred to the necessity for the fixation of atmospheric nitrogen, has attracted wide attention. The importance of the problem referred to is certainly paramount compared with any other before either the scientific or commercial world to-day, though the vast majority of people are not aware of that fact. Prof. Crookes is entitled to thanks of thinking people for having called attention so sharply to this very important subject.

In the address in question I failed, however, to find anything throwing additional light upon the solution of the problem. The fixation of atmospheric nitrogen by the electric spark has long been known as well as it is now. Prof. Crookes' present estimated cost through steam power by electricity, £26, or about $130 per ton of "nitrate of soda," which I suppose to mean the combination of the 15 per cent. nitrogen contained therein, is far beyond reach commercially, with nitrate of soda selling at about $40, and sulphate of ammonia at about $44 per ton; the latter containing about 20 per cent. of nitrogen. His estimate of a cost of £5, or $25, per ton of nitrate of soda, or, I presume, its equivalent in combined nitrogen, is based upon an arbitrary cost of Niagara water power, which is probably less than that power can be bought for. Even upon such an estimate the probabilities for commercial success do not seem as promising as by the use of other methods. Electric heat, in my opinion, cannot compare in low cost with heat from the combustion of coal under the most approved conditions, except in concentrated work. I have strong hopes, however, that something will be accomplished in the direction indicated by the use of electricity in the production of cyanides, a most desirable form of combined nitrogen.

So far as the estimated cost of combined nitrogen by electricity is concerned, as given by the press as a part of Prof. Crookes' lecture, it is not to be compared with results obtained in England as long ago as in the years 1844–7, by Bramwell and Hughes, at which time, upon the most reliable data obtainable, yellow prussiate of potash (ferrocyanide) was produced in large quantities, utilizing the nitrogen of the acid, at a cost of about 20 cents per pound. This product is now worth 15 cents per pound. Bramwell and Hughes, it will be seen, were working down tolerably close to a commercial success. They gave as the reasons for their failure to reach this desired point: First, loss of a large proportion (two-thirds sometimes) of the alkali used—potash; second, the inferiority of their firebrick; and, third, the expense of maintaining the necessarily high temperatures. The price their product brought I have not at hand.

Since 1847 there have been many changes. Fawcett has recorded a line of experiments on the same general plan, in which he reduced the loss of his alkali to from 10 to 20 per cent., and advises that by special arrangements this loss could be reduced. I presume that potash is much cheaper now than then also.

The quality of firebricks has improved immensely since then, and the production of high temperatures at lowered cost has changed in favor of the present, from about 12 per cent efficiency to about 60 per cent., the Siemens' producer gas process having not been invented until about 15 years after the conclusion of the work of Bramwell and Hughes. In view of these contrasts the present would seem to offer encouraging conditions, even with old processes and methods.

I might have added another reason given by Bramwell and Hughes for their failure; viz., insufficient carbon surface which was exposed to the action of the alkali, the nitrogen and the heat. The carbon they used was the size of hazel nuts, and the alkali melted and covered the surfaces. This fact has since been seized upon by one inventor to use his carbon in a ground form. Experiments were carried on in this country upon that idea, but the operation was not successful. The patents called for, in producing the necessary temperature (about 2,200° F.), the burning of the furnace gases to CO_2, in the predominating presence of which the inventor found, as Mond had found before him, cyanides, one of the steps in the operation in question, could not exist. It is interesting to note, however, that in experiments with these patents, made in Pittsburg, that loose quantities of ammonia were produced, the cyanides being decomposed by steam. Natural gas was used as the combustible in the Pittsburg work. At about the time that this work was looked over by one of the chief chemical interests of this country, which practically decided to take the same up and push it earnestly, a new process was brought out, known as the hydrocarbon process. This seemed to make it plain that the Pittsburg results had been obtained through the use of a hydrocarbon—the natural gas, over 90 per cent. marsh gas; and the ground carbon patents then became dependent upon the hydrocarbon patents.

The use of a hydrocarbon as a source of carbon was ideal, so far as "surface" was concerned. It also possessed the other strikingly important feature that, whereas the vaporization of the inert, fixed carbon was extremely difficult, the vaporization of a hydrocarbon was comparatively easy; and more, that in this act was accomplished another—that instead of dealing with an inert substance, as in fixed carbon, in the decompositon of the hydrocarbon the carbon was endowed with intense chemical energy, and a complete change was readily brought about in the characteristics of a chief factor in the operation. This change could not be effected desirably, however, in the presence of free oxygen or CO_2. Then the question arose, how could the combustion be confined to CO (about 4,400° F.), and at the same time secure a temperature necessary to the desired reaction, which is supposed to be from 2,000° to 2,200° F.

After many trials in heating the elements of combustion and then reducing the flame from CO_2 to CO, a way out of this difficulty seems to have been found in a very simple manner—viz., the preheating of producer gas by accepted methods, and the use of this preheated gas as the source of heat in the furnace wherein the reactions occur, the gas in question serving not only as a conveyer of heat, but also of atmospheric nitrogen.

Fawcett holds with others, and no doubt correctly, that the presence of CO in the cyanidizing chamber acts as a diluent, and consequently reduces the yield. Let this be as it may. If producer gas can thus be used, of which there seems to be little doubt, then the introduction of such gas, heated to the proper degree and conveying the nitrogen, meeting and mixing in a retort from which air is excluded, with a supply of alkali and *predominating* decomposing hpdrocarbon, would seem to furnish the conditions necessary to success. That cyanate and cyanide have been produced and decomposed by steam with ammonia and a fuel gas as the final result, under these general conditions, there can be little doubt. It was in this work, which was proceeding successfully last year in Philadelphia, that the well known Engineer, Mr. Geo. H. Sellers, was burned to death. For the surrounding circumstances and conditions Mr. Sellers was producing such results as were most reassuring to those interested. His sad death brought the work to an abrupt close, just as he was reaching the point in his labors when the unquestioned results obtained would have been recorded quantitatively.

The study of this hydrocarbon process has been close and systematic. In it is included interesting phases of heat engineering, gas engineering and chemistry. The various phases of the study have been followed thoroughly. The theory as a whole has been reduced to a form where it may be more readily studied than ever before. Scientific opinion, originally generally against the operation, has been converted in almost every instance. And it appears that under this process conditions have been worked out which seem to be closely parallel with those which Bunsen and Playfair found existing at the blast furnace in England, where cyanides were produced plentifully daily, though accidentally, many years ago.

A close study of the whole important question seems to indicate that a systematic effort on the lines indicated would be rewarded with success. It is certainly a grand and inspiring work, offering as a reward immense financial gain and immeasurable good to the commercial world.

[Translated from the *Journal des Usines a Gaz*, by Mr. Herman Poole, F.C.S.]

Introduction of Incandescent Gas Burners for Public Illumination at Paris.

The city of Paris and the Paris Gas Company have just installed the Denayrouze incandescent gas burner in the principal streets and squares of Paris.

Around the Opera, the group of streets thus lighted is composed of la Rue Auber, la Rue du Havre, la Rue Scribe, la Rue Glück, la Rue Meyerbeer and a portion of the Boulevard Haussman. The same illumination is used in the Place du Palais Royal, the Place de l'Hotel de Ville and the Rue du Quatre-Septembre.

These new installations have been made by simply substituting the Denayrouze apparatus for the old burners. The lanterns used are all of the type common in the city of Paris.

The different models which have been adopted according to the extent and ground to be illuminated are the triple, the double or the

single burner, giving respectively a light equivalent to about 518, 345 and 173 candles.

The effect obtained equals and exceeds that produced by the most powerful electric lights in use at Paris; and a very marked difference is manifest immediately in favor of the first mentioned of the two modes of illumination, upon comparing the illumination of the Rue Auber with that of the Place de l'Opera.

It may be admitted, then, as a result attained, that the gas industry is able to-day to successfully oppose the light of the electric arc, which seemed till now exclusively reserved for the illumination of large city streets. This can now be had by using the perfected types of gas burners used in illumination by incandescence.

Besides the luminous intensity thus realized, the economy derived from the adoption of this system must be considered. The triple Denayrouze burner has been substituted for the recuperative burners formerly in use in the streets above mentioned. If we consider that a candle power is obtained in those last burners with a minimum consumption of nearly 1½ cubic feet of gas per hour while the Denayrouze burners give it with only six-tenths of a foot, we see the advantage derived by the city of Paris by the change.

Moreover, the establishment of this system requires not the least modification in the installations already existing (piping, works, lanterns, etc.). This advantage is of the utmost importance, especially from the point of view of comparison with electricity, the installations of which always entail very high expenses in establishment.

In putting up the apparatus the Denayrouze Company has taken several necessary precautions with a view of protecing the mantles from vibrations of the earth and danger of breaking due to variations of pressure. To obviate the first inconvenience the burners have been furnished with mercury anti-vibrators.

The gas enters a very small bell, like a little gasometer, having a mercury seal. A depth of one-half to three-quarters of an inch is found sufficient for the heaviest pressures. This very sensitive apparatus gives the best results.

Besides this, regulators have been put under each burner so as to guarantee a constant outflow. The deteriorations of the mantles due to excessive consumption of gas when the pressure increases are thus prevented; and as no glass chimneys are used, the breaking of chimneys and the consequent loss of mantles are entirely done away with.

It has been already established that under these conditions the life of the mantles is increased in a very marked degree.

At first view of the new illumination the general appearance produces a feeling of a powerful brightness to which we are not accustomed. Rue Auber, among others, appears actually illuminated, the more so as the adjacent quarters appear by contrast to be plunged in darkness.

In spite of its intensity, the light is pleasant to the eye, and it does not present those brilliant points and that unbearable brightness with which the electric lamps are justly accused.

We attribute this effect to the fact that the incandescence is spread over the entire surface of the mantle and, consequently, the intensity of the flame is at any given point relatively much less than in the electric arc.

Finally, in the competition which gas companies have had with the electricity, they will have here at their disposal a solution of which the consecration is to be found in the Paris experiences.

The Chemical Composition and Technical Analysis of Water Gas.[1]

[By Mr. Edward H. Earnshaw, Chemist to the United Gas Improvement Company.]

As is well known, water gas is a product of the reaction between steam and incandescent carbon, whereby there is formed a mixture of carbonic oxide and hydrogen in approximately equal volumes. This mixture, technically called "blue gas," has of course no illuminating value, and it is therefore enriched by exposing it together with hydrocarbon vapors to the action of intense heat. The hydrocarbon vapors are thus permanently gasified, or "fixed," and impart a high illuminating power to the mixture. This is carbureted water gas, more familiarly known simply as water gas.

The enriching material employed is always petroleum in some form, usually as crude oil, naphtha, or a distillate called gas oil, which during the "fixing" process is converted into hydrogen and gaseous hydrocarbons, together with naphthaline, benzene and its homologues, and the other pungent empyreumatic compounds found in coal gas, and formed in that case by the contact of the gas with the hot sides of the retorts. The odor of coal gas is due to these empyreumatic compounds, and therefore, as might be expected, the odor of water gas is similar, but even more penetrating.

The chemical composition of coal gas and water gas is essentially the same; that is to say, the same constituent gases enter into the composition of each mixture, but the relative proportions vary. This is illustrated by the following analyses of coal gas and water gas respectively. The figures given are of actual analyses, but are fairly representative of each class:

	Coal Gas.	Water Gas.
Benzene vapor	0.50 per cent.	0.6 per cent.
Heavy hydrocarbons	4.25 "	12.8 "
Carbonic oxide	8.04 "	30.7 "
Hydrogen	47.04 "	32.4 "
Marsh gas	36.02 "	13.9 "
Higher paraffines	0.00 "	2.4 "
Carbonic acid	1.60 "	2.7 "
Oxygen	0.39 "	0.7 "
Nitrogen	2.16 "	3.8 "
	100.00 "	100.00 "

The composition of the heavy hydrocarbons, or "illuminants," varies greatly with circumstances, both with coal and water gas, though they always consist chiefly of ethylene and other members of the olefine series, together with small quantities of other hydrocarbons of which acetylene is probably the most important.

From the gas analyst's point of view, the most important feature of the composition of water gas is the presence of notable quantities of paraffines other than marsh gas, since this involves a modification of the methods of analysis commonly in use, and which presuppose that marsh gas is the only paraffine present in the gas mixture.

This is the point that I chiefly desire to bring to your attention to-night.

The Analysis of Water Gas.—The scheme of analysis, as far as the absorbable constituents of the gas mixture are concerned, follows the plan elaborated by Hempel, and is as follows:

(1) The vapors of benzene are first absorbed by shaking the gas in an explosion pipette over mercury with 1 c.c. of alcohol, previously saturated for the less easily absorbable constituents. The vapor of alcohol is absorbed in another explosion pipette by 1 c.c. of water, and the resulting contraction measured.

(2) The carbon dioxide is absorbed by potassium hydrate in a pipette filled with small rolls of iron wire gauze.

(3) The heavy hydrocarbons, or fixed illuminants, are absorbed by a saturated aqueous solution of bromine. The vapors of bromine are absorbed by potassium hydrate, and the contraction measured.

Fuming sulphuric acid may be used instead of bromine, but it is much more difficult and inconvenient to handle, and the results obtained are scarcely more accurate.

(4) Oxygen is absorbed by phosphorus. Some chemists urge the use of an alkaline solution of pyrogallic acid, claiming that the action of phosphorus is unreliable. I have found, however, that in every case where the phosphorus has failed to act it has been due to incomplete absorption of the illuminants. Therefore, whenever, on testing for oxygen, the white fumes of phosphoric acid fail to appear, the gas should be passed once more into the bromine solution. I have never yet analyzed a gas that did not contain at least a trace of oxygen. I strongly favor the use of phosphorus because the results obtained are at least as accurate as with pyrogallol, and because the appearance of the white fumes is absolute proof of the presence of oxygen, and indicates as well that the illuminants have been completely absorbed.

(5) The carbonic oxide is now absorbed by an ammoniacal or hydrochloric acid solution of cuprous chloride.

At least two pipettes should be used for the absorption, the last one containing a perfectly fresh solution. It is important to notice that even with this precaution the absorption of the carbonic oxide is seldom complete, usually about 0.5 per cent. remaining unabsorbed. This fact introduces no error in the analysis, as this residue of carbonic oxide can be determined later, as will be shown.

The residue of the gas mixture now remaining may be as follows:

(a) $(H_2) + (CO) + (N_2) + (CH_4) + (C_2H_4) + (C_3H_6)$, etc.

But for all ordinary purposes it is sufficient to assume that the only higher paraffine present is C_3H_6.

There being no satisfactory known absorbent for any of these gases it becomes necessary to have recourse to the method of combustion.

1. Read at a stated meeting of the Chemical Section of the Franklin Institute.

A portion of "a" is then mixed with a measured volume of air and exploded over mercury in an explosion pipette. The contraction in volume is measured, the carbon dioxide formed is determined by absorption with potassium hydrate, the excess of oxygen absorbed by phosphorus, and the volume of the residual N is noted.

The equations are:

(1) Contraction in volume $= \frac{3}{2}(H_2) + \frac{1}{2}(CO) + 2(CH_4) + 2\frac{1}{2}(C_2H_4)$

(2) CO_2 formed $= (CO) + (CH_4) + 2(C_2H_4)$

(3) Residual nitrogen $= (N_2) + (N_1)$,

where N_1 is the nitrogen introduced with the air. The amount of nitrogen thus introduced may with sufficient accuracy be taken at 79.2 per cent. of the measured volume of air.

An examination of these equations shows that the nitrogen may at once be ascertained from equation (3), but equations (1) and (2) contain four unknown quantities, and therefore two more equations are needed for the solution. Fortunately the method of fractional combustion over palladium affords the needed information. As is well known, when a mixture of hydrogen and CH_4 with oxygen or air is passed with the proper precaution over heated palladium black, the hydrogen burns to H_2O, but the CH_4 is unaltered. If CO and any of the higher paraffines are also present, the CO burns, but the paraffines do not. If, then, the products from the combustion are received in a pipette over mercury, it is possible to subsequently measure the amount of CO_2 formed by the burning of the CO.

Returning to the analysis, a second portion of (a) is taken, mixed with air, and burned over palladium black. The resulting contraction and the CO_2 formed are measured. The equations are:

(4) Contraction in volume $= \frac{3}{2}(H_2) + \frac{1}{2}(CO)$.

(5) CO_2 formed $= CO$.

From these two equations the values for hydrogen and CO may be readily calculated.

For simplicity's sake let us now assume that the same quantity of gas mixture (a) was used on both the explosion and the combustion. We may then subtract equation (4) from (1), and (5) from (2), whence, designating the difference between the contraction due to explosion and that due to combustion by the letter (a) and the difference in the CO_2, formed by the letter (b), we find

(6) $2(CH_4) + 2\frac{1}{2}(C_2H_4) = a$.

(7) $(CH_4) + 2(C_2H_4) = b$.

(8) whence $C_2H_4 = \frac{4b - 2a}{3}$.

(9) $CH_4 = \frac{4a - 5b}{3}$.

A very useful check on the accuracy of this determination is obtained from the following:

Volume of gas taken for explosion $= H_2 + N_2 + CO + CH_4 + C_2H_4$. H_2 and CO are found by (4) and (5), and N_2 is given by (3). Therefore we have,

(10) Volume taken $- (H_2 + N_2 + CO) = CH_4 + C_2H_4$, and this value should be the same as the algebraic sum of (8) and (9), or,

(11) Volume taken $- (H_2 + N_2 + CO = \frac{2a - b}{3}$.

This scheme of unalysis is perfectly correct for gas mixtures containing no higher paraffine than C_2H_4, but what would happen in case C_3H_6, C_4H_{10}, etc., were present?

Our gas mixture would then contain P volumes of hydrocarbons of the formula $C_n H_{2n+2}$, and would be,

Gas mixture $= H_2 + N_2 + CO + P(C_n H_{2n+2})$.

As will be shown later, the contraction in volume due to the combustion of P volumes of any hydrocarbon of the general formula $C_n H_m$ would be

$$P(1 + \frac{m}{4})$$

and the CO_2 formed would be Pn. But in this case, $m = 2n + 2$, and therefore we have,

From the explosion:

(12) Contraction in volume

$$= \frac{3}{2}(H_2) + \frac{1}{2}(CO) + P + \frac{Pn + P}{2}$$

(13) CO_2 formed $= Pn + CO$.

And from the combustion over palladium:

(14) Contraction in volume $= \frac{3}{2}(H_2) + \frac{1}{2}(CO)$.

(15) CO_2 formed $= CO$.

Subtracting (14) from (12) and (15) from (13), as before explained, we have,

(16) Difference in contraction

$$P + \frac{Pn + P}{2} = a$$

(17) Difference in CO_2 formed $= Pn = b$; whence,

(18) $$P = \frac{2a - b}{3}$$

(19) $$n = \frac{3b}{2a - b}$$

Equation (18) is identical with (11), and hence it appears that the method is correct as far as the total volume of paraffines is concerned, even though higher paraffines than C_2H_4 are present.

Having thus examined the theory of the analysis by combustion, let us follow the figures of an actual analysis.

The gas was a water gas, enriched by naphtha, and its candle power was 23.5.

Amount taken for analysis.....	100.0 c.c.
C_2H_4 absorbed by alcohol.....	0.4 per cent.
CO_2 absorbed by potash.....	2.7 "
Illuminants absorbed by bromine..	11.7 "
Oxygen absorbed by phosphorus..	0.5 "
CO absorbed by cuprous chloride..	31.7 "

Of the unabsorbed residue of 53 c.c., 14.05 c.c. were mixed with 87.8 c.c. of air, and exploded by a spark in an explosion pipette over mercury. The resulting contraction in volume was 22.60 c.c. The CO_2 absorbed by potash was 5.30 c.c.; the surplus oxygen absorbed by phosphorus 3.80 c.c.; the residual nitrogen, 70.1 c.c. consisting of nitrogen from the air, 69.50 c.c., and nitrogen from the gas, 0.60 c.c.

A second portion of 30 c.c. was now mixed with 70 c.c. of air and the mixture passed over palladium black to burn the hydrogen and CO.

The contraction in volume was 30.40 c.c.

CO_2 absorbed by potash was 0.40 c.c.

To calculate the percentage of hydrogen, CO, CH_4, C_2H_4 and nitrogen according to the method already theoretically explained, we proceed thus:

$$CO = \frac{0.4 \times 53}{30} = 0.70 \text{ per cent.}$$

$$\text{Hydrogen} = \frac{(30.4 - 0.2) \times 53}{30} \times \frac{2}{3} = 35.57 \text{ per cent.}$$

Now, as 30 c.c. of gas were taken for the combustion and only 14.05 c.c. for the explosion, we must calculate the contraction in volume and amount of CO_2 that would have resulted from the combustion of 14.05 c.c. over palladium; thus:

Contraction in volume would be—

$$= \frac{30.4 \times 14.05}{30} = 14.24$$

CO_2 formed would be—

$$= \frac{0.40 \times 14.05}{30} = 0.18$$

Subtracting these figures from the results of the explosion, we find—

$$22.60 - 14.24 = 8.36 = a$$
$$5.30 - 0.18 = 5.12 = b$$

and hence, from (8) and (9)—

$$C_2H_4 = \frac{20\,48 - 16.72}{3} = 1.25$$

$$CH_4 = \frac{33.44 - 25.60}{3} = 2.61,$$

and therefore,

C_2H_4 in orginal gas—

$$= \frac{1.25 \times 53}{14.05} = 4.71 \text{ per cent.}$$

CH_4 in original gas—

$$\frac{2.61 \times 53}{14.05} = 9.84 \text{ per cent.}$$

Nitrogen in original gas—

$$= \frac{0.60 \times 53}{14.05} = 2.26 \text{ per cent.}$$

Applying equation (11) as a check on the accuracy of the determination, we find:

$$14.05 - (9.43 + 0.60 + 0.18) = \frac{2\,(8.36) - 5.12}{3}$$

or, 3.84 = 3.86, which is a difference well within the limit of errors of observation.

In the calculation of this analysis we have assumed for convenience sake that there are no paraffines present other than CH_4 and C_2H_6. Of course, it is possible and indeed probable that higher members of the series are actually present, so that while the figures obtained in our calculations truly represent the total quantity of paraffines contained in the gas, yet they may not be true as regards the actual composition. The composition of the average molecule of the paraffines may be obtained from equation (19), thus:

$$n = \frac{15.36}{16.72 - 5.12} = 1.32$$

whence the average composition of the paraffines $C_n H_{2n+2}$ would be C1.32 H4.64.

The value of this method in giving an accurate conception of the actual composition of a gas mixture, is clearly brought out by comparing the figures just given with those obtained by the more usual methods of calculation.

These methods are: (1) when no combustion over palladium is made, and the hydrogen is determined by subtracting twice the volume of CO_2 formed in the explosion from the contraction in volume, and calling the difference the contraction due to hydrogen. (2) The method recommended by Hempel, who directs that the hydrogen should be determined by combustion over palladium. The contraction in volume due to the percentage of hydrogen thus found, is subtracted from the total contraction due to the explosion, and the remainder is considered to be the contraction due to CH_4, which is, of course, equal to twice the volume of CH_4. Both these methods presuppose that no paraffine other than CH_4 is present, and that the CO has been completely absorbed by cuprous chloride.

	Calculated by Method Given Above.	By Method Without Combustion over Palladium.	By Method According to Hempel.
Benzene vapors	0.40	0.40	0.40
Fixed illuminants	11.70	11.70	11.70
Carbonic oxide	32.40	31.70	31.70
Hydrogen	35.57	30.34	35.84
Paraffines C_2H_6	4.71	..	..
Paraffines CH_4	9.84	20.00	16.30
Carbonic acid	2.70	2.70	2.70
Oxygen	0.50	0.50	0.50
Nitrogen (by difference)	2.18	2.66	0.86
	100.00	100.00	100.00

The method without separate determination of hydrogen is the simplest both in method and in apparatus required, and is, therefore, the one in most general use.

In the analysis of water gas by this method, let us consider the equations resulting from the explosion of 15 c.c. of a gas mixture composed of

Hydrogen	10.0 c.c.
CH_4	3.0 "
C_2H_6	1.5 "
Nitrogen	0.5 "
	15.0 "

The resulting equations would be:

Contraction in volume	$= \frac{3}{2}(H_2) + 2(CH_4) + 2\frac{1}{2}(C_2H_6)$	$= 24.75$
CO_2 formed	$= (CH_4) + 2(C_2H_6$	$= 6.00$
Volume of gas taken	$= H_2 + CH_4 + C_2H_6 + N_2$	$= 15.00$
Nitrogen	$= N_2$	$= 0.50$

At first it would seem that these equations could be easily solved, and that no more data would be required for the correct computation of the composition of the gas mixture. An attempt to solve the equations, however, discloses the fact that the problem is indeterminate, and that the equations can be satisfied by any value of C_2H_6 from 0 to 3.

Thus:

Let C_2H_6	= 0.	Let C_2H_6	= 3.00
Then, H_2	= 8.50	Then, H_2	= 11.50
CH_4	= 6.00	CH_4	= 0.00
C_2H_6	= 0.00	C_2H_6	= 3.00
N_2	= 0.50	N_2	= 0.50
	15.00		15.00

We may perhaps find in this circumstance an explanation for the continued use of this method by many analysts without suspecting the incorrect application to gas mixtures containing higher paraffines than methane. The analysis would always "add up well," and the amount of nitrogen found would be correct.

(To be Concluded.)

Ohio Coal Production in 1897.

Chief Mine Inspector R. M. Haseltine has filed with the Governor his annual report for the year 1897. The industrial portion of the report is subdivided into 26 subjects, all of which are treated in detail. Then follow the reports of the seven district inspectors, giving the inspections made by each. Next appear the list of mines, quarries, mine owners, their post office addresses, etc., making in all 39 subdivisions of the work performed by the department during the year.

From a table designed to show the coal delivered at the lake ports it is found that the amount aggregates 7,997,248 tons. Of this 2,745,130 tons was anthracite and 5,252,118 tons was bituminous coal. This indicates a loss in the former of 435,592 tons and 513,487 tons in the latter. Of the bituminous coal sent to the lake ports, 3,326,814 tons came from the mines of Pennsylvania, as against 4,337,815 tons during 1896. From the Ohio fields there was received 1,355,138 tons, an increase of 88,103 tons as compared with the preceding year. This represents $25\frac{5}{10}$ per cent. of the bituminous coal received at the lake ports, as compared with $21\frac{8}{10}$ per cent. during 1896, $32\frac{2}{10}$ per cent. during 1895, $28\frac{8}{10}$ per cent. in 1894, 46 per cent. in 1893, and 45 per cent. during 1892. From the State of West Virginia there was received 565,166 tons, a gain of 406,449 tons over the year of 1896. This represents $10\frac{3}{4}$ per cent. of the year's coal, as compared with $3\frac{6}{10}$ per cent. in 1896, $6\frac{1}{2}$ per cent. during 1895, and $5\frac{3}{10}$ per cent. in 1894.

From the statistical portion of the report the year's production of coal is given at 12,448,822 tons, a decrease of 463,786 tons as compared with the preceding year and a loss of 1,235,057 tons when compared with the tonnage of 1895. By comparing the footings of this table with those of the previous year, it is found that the loss in lump coal was 321,407 tons; in nut coal, 107,294 tons, and the decrease in the amount of pea or slack is given at 35,085 tons. The 10 leading counties in point of production are Jackson, Perry, Hocking, Athens, Belmont, Guernsey, Stark, Jefferson, Columbiana and Tuscarawas, which appear in the order named. They furnish $86\frac{1}{4}$ per cent. of the year's output, which is a gain of $4\frac{1}{4}$ per cent. when compared with 1896. As compared with the preceding year, it is found that Jackson county, which led in 1895 and gave way to Perry in 1896, has again assumed the lead and Perry drops back to the second place. Athens, which was third, retreats to the fourth position, which was formerly occupied by Hocking. The remaining counties appear in the same order as during 1896, with the exception of Columbiana, which advanced from the tenth to the ninth position, Tuscarawas being the last. The counties of Athens, Perry and Hocking, which are known to the coal trade as the "Hocking Valley," produced 4,130,046 tons, a loss of 308,990 tons as compared with the year of 1896. This represents a decrease of 1 per cent. when compared with the former year, when the output equaled $34\frac{2}{10}$ per cent. of the entire production of the State. It further represents a loss of $\frac{8}{10}$ per cent. as compared with 1895, $3\frac{5}{10}$ per cent. when compared with 1894, $5\frac{2}{10}$ per cent. as compared with 1893, and $4\frac{6}{10}$ per cent. as compared with 1892.

Of the year's coal production, 4,106,124 tons were mined by machinery, which is a gain of 737,775 tons as compared with 1896 and is the only gain in production in this subdivision of the report. Machine mining has extended to 12 counties as against 11 during 1896 and 7 in 1895. The largest production occurred in the counties of Hocking, Athens, Perry and Guernsey. In the three former, 78 per cent. of the State's production originated. This is a decrease of 18 per cent. of the State's production compared with 1894 and 1896 and a loss of 15 per cent. when compared with 1895; 732 hands were engaged in operating the machines, as against 579 in 1896. There were 5,001 men engaged in blasting down and loading out the coal after being undermined by the machines, as compared with 4,346 during the preceding year. The average time worked is found to be 135 days, as against 132 during the previous year and 168 during 1895. Coal is produced by machinery in 53 mines, as compared with 44 during last year. Installations were made at the Half Moon or No. 3 mine in Athens county, the Slope of the Ohio and Pennsylvania Coal Company in Columbiana, Mathews' No. 3, Cisco and Klondyke in Guernsey, Tom Corwin No. 2, Milton Nos. 1 and 2 and Alma in Jackson, Lost Run No. 2 in Jefferson, Charter Oak in Meigs and Congo No. 2 in Perry county. Federal Valley No. 3 in Athens and New Pittsburg No. 6 in Hocking remained idle,

and from the Brock Hill mine in Tuscarawas county the machinery was removed. At the close of the year there were 166 electric machines and 67 which used compressed air distributed throughout the mines of the State.

There were 1,228 mines in the State, 413 of which employed more than 10 men; 1,126 mines were in operation during the year, 37 of which are regarded as large mines. The number of active mines returned is 30 in excess of the number reported during any year of which the Department has a record. The average time worked is given at 150½ days, the same as during the year of 1896. The number of miners employed amounted to 22,131, a loss of 14 when compared with the past year. There were 6,654 day hands, a gain of 353 as compared with 1896.

By deducting from the total output of the State the amount of machine mined coal, it is found that 8,342,698 tons were produced by pick mining, a decrease of 1,201,561 tons as compared with the former year. This makes an average yearly production to each miner of 508 tons, 1,537 pounds of run of mine coal, which is an individual loss of 45 tons and 963 pounds as compared with the previous year and of 57 tons 1,574 pounds when compared with 1895.

The scale rate for pick mining from January 1st to July 4th was 51 cents per ton. From the close of the strike (September 11th) to the end of the year it was 56 cents per ton. The average price paid for mining during the year is found to be 52 $\frac{8}{10}$ cents. The average amount of fine coal is conceded to $\frac{2}{3}$ of the output. Thus it will be seen that the daily wages of each miner was $1.27 during the 150½ days that the mines were in operation. It is also found that the average yearly wages was $192.05 as compared with $221.55 during the year of 1896, or $16 per month as against $18.46 in 1896 and $18.48 during 1895.

During the year 89 new mines were opened, 102 remained suspended and 97 were either exhausted or abandoned. There were 1,647 inspections made by the members of the Department and 204 permanent improvements were made; 77 sets of scales were tested, 18 of which were found to be inaccurate. Of this number 3 are reported as discriminating against the miner and a like number were in his favor.

The iron ore production was confined to the counties of Jackson, Lawrence and Scioto and equaled 50,267 tons of the hematite variety, which is a loss of 20,498 tons as compared with 1896.

The 18 counties which show a production of fireclay return a total of 822,727 tons, an increase of 4,813 tons as compared with the former year.

The average time worked is given at 25½ weeks, a loss of 6½ weeks as compared with 1896; 655 men were employed as miners and 3,317 hands were engaged in the manufacture as compared with 601 miners and 3,139 day hands during 1896.

In the production of limestone the returns show a loss in five of the nine classifications into which it is prepared for the market. The time worked is given at 131 days, an average loss of 2½ weeks. The number of men employed is given at 3,398 which is a gain of 212 as compared with the previous year.

There were 277 casualties reported. Of this number, 40 were fatal, 142 were serious in their nature and 95 were of minor consequence. There were 311,220 tons of coal mined to each life that was lost, as compared with 314,942 tons during 1896. There were 87,667 tons produced to each serious injury received and 44,841 tons were secured to each casualty that occurred as compared with 64,563 tons during 1896; 35 $\frac{4}{10}$ per cent. of the accidents were due to falls of roof, 17 $\frac{3}{10}$ per cent. to falls of coal and 25 $\frac{3}{10}$ per cent. were due to contact with mine cars. To premature explosions of powder 5 $\frac{8}{10}$ per cent. were due. But two fatalities originating from unusual causes occurred during the year. John Brown was murderously assaulted with a miner's pick at Bergholtz in Jefferson county, and Wesley McHenry, from the effects of a fall against a live wire, was killed in the Hartford mine on February 17th.

The former accident is not properly a calamity for which the Department is responsible, which if deducted, reduced the year's fatalities to 39, a decrease of 2 as compared with the former year.

Light carbureted hydrogen gas (fire damp) was present in 34 mines as compared with 38 during 1896. These were distributed over nine counties; 4 serious and 1 minor accidents are reported as emanating from this source. When it is considered that in addition to the natural perils of mining there was exploded 170,968 kegs of powder, an amount equaling 2,128½ tons in the mines of the State, the number of casualties occurring cannot be considered as excessive.

The report contains many tables illustrating in detail the salient features of the industry, which are placed under appropriate headings and arranged so as to be convenient for ready reference.

Mechanical and Economical Problems of the Coal Question.

Engineering in its report of the meeting last month at Bristol, of the British Association for the Advancement of Science, says that a paper which attracted great attention was read by Mr. T. Foster Brown. Mr. Brown considered the "Mechanical and Economical Problems of the Coal Question," and a free abstract of his remarks, with a like abstract of the discussion, is appended:

The paper first pointed out that though our coal resources extend over wide areas, it is the most available and the most valuable, that are first attacked and exhausted. These are seams which are workable by free drainage levels, without pumping or winding, and such seams were probably the main source of our coal supply up to about the middle of the present century. Next follow the best of the thick seams at a reasonable depth. These will be for a considerable time the principal source of our coal supply. There remain the thin and inferior seams existing at shallow depths and all seams two thousand feet or so, down to the extreme limit of workable depth. These larger resources are still practically intact. The author very aptly said, and it is difficult to induce the public to realise the supreme importance of the fact, that it is only the best and cheapest of our coal resources which supply our existing output. The amplitude of our *total* coal resources is not the probable true limit, in time, of our commercial supremacy, but it is the duration of the best and cheapest deposits only that is the true measure of our prosperity; so far, of course, as can be judged by present knowledge. In other words, there may remain, at the end of a given period, vast quantities of coal beneath the surface, but it may be so difficult to mine or may be of such inferior description as to be unable to compete with foreign supplies. This, of course, is an obvious fact, but it is, like so many others, one which is generally overlooked, especially by a class of statists and economists—much in evidence—who take their figures in the lump without stopping to analyze their value. It is experts of this kind to whom we owe the expression, "Anything can be proved by statistics."

The author's estimate (based on the calculations of Professor Hull) is that a total 66,683,000,000 tons exist in the region of best coal, between a depth of 2,000 and 4,000 feet, together with the coal of thin and inferior seams at all depths to the limit of 4,000 feet. He further estimates that we shall have exhausted ½ths of our best resources about the year 1950, and have arrived at a stage when our whole annual output will be composed of a rapidly increasing proportion of deep, thin, or inferior coals. There will then remain coal workable at a gradually increasing cost sufficient for the supply of the nation for a period of upwards of 250 years, supposing the annual output to be 250,000,000 tons a year. Unless steps can be taken to diminish the cost of producing the coal, the increasing charge involved will be of serious moment to the nation. The nearness of our coal fields to ports and centres of consumption is a point in our favor, but an enhanced price must hamper our progress commercially by increasing the cost of home manufactures, and the rates at which steamships can be worked. This in itself will naturally lessen our coal exports, and thus increase the cost of imports of raw material and food supplies, and gradually take from us the advantage we have over other nations in the home and foreign trade. This effect may be gradual and comparatively imperceptible for 50 years or so, owing to the continual development of the unopened portions of our coal fields, and the resources of good and thick seams still unworked.

Having arrived at this point, the author discussed generally the direction in which it may be practicable to improve existing appliances for working coal. In speaking of coal-cutting machinery he referred to the Stanley heading machine, which is purely a tunnelling machine, being almost useless for opening thin seams unless the floor or roof is soft. Under favorable conditions it can be driven four times as quickly and at about double the cost of hand labor. A type of machine adapted for headings or rooms, and consisting of a sliding frame conveying either a cutter bar or a chain cutter, has been developed in America. They are adapted for thick seams with good roofs. The bar cutter type is giving way to the chain cutter type. With a machine driven electrically the cost of cutting amounts to 6d. per ton, as against 1s. per ton for hand labor. For continuous long wall faces, disc cutters, chain cutters, and bar cutters are used. The former are economical if the conditions are favorable, 120 workmen in one instance doing as much as 173 men could accomplish by hand labor. With bar cutters the saving over hand labor has been from 6d. to 7d. per ton. Percussion drills mounted on wheels are useful where the holing is very hard, but under ordinary conditions they cannot compete in speed with disc

or revolving cutters. In dealing with underground haulage the author considers that with steam engines fixed on the surface, and ropes carried down the shaft, the greatest economy is obtained for existing collieries, but with increasing depth a limit will be reached for practical working. Electrical haulage, although it has been applied successfully in some cases, is attended by risk in mines giving off fire damp. The useful effect does not exceed 65 to 70 per cent. in deep mines. Compressed air, though costly, is the most useful method of conveying power, the exhaust air being of great advantage for refreshing the colliers. The author is of opinion that by improvements in motive machinery the efficiency can be brought from an existing 25 per cent. to 50 per cent. He would heat the air before use, by hot water brought from the surface. He estimates the cost of primary haulage from 2d. to 4d. per ton mile. Secondary haulage, usually performed by horses or ponies, costs from 1s. 2d. to 1s. 8d. per ton mile. Mechanical appliances might be substituted with advantage, and would effect a saving of 4d. to 6d. per ton mile.

In winding engines, improvements have been made by balancing and condensing, and in the quality of wire ropes. Separate condensers and higher piston speeds, with smaller drums, might be adopted. Corliss engines have been used, one pair lifting 55 cwt. of coal from a depth of 310 yards in 26 seconds. In regard to pumping, the presence of water at great depths is comparatively rare ; and the higher temperature met with in deeper workings will assist ventilation. In spite of this the increased heat that is present in deep mines is a most serious obstacle to working the lower seams. The rate of increase is generally about 1° for every 60 feet, or 91° at 2,500 feet, 99° at 3,000 feet, and 116° at 4,000 feet ; the latter being the probable limit of depth at which coal could be worked as fixed by the Coal Commission of 1871. The immense volume of air needed for artificial cooling renders any application of the freezing process out of the question. With long wall working and packing empty spaces it may be possible to reduce the temperature alongside the air passages at 3,000 feet to 4,000 feet by 15° to 25° F.

Having discussed the mechanical aspect of the question, the author proceeded to deal with those points which have a bearing more especially on the financial or commercial side of the problem. He says the cost of working coal has even now a tendency to increase. This is chiefly due to the greater cost of labor and the extra charges for rates and taxes. The former he considers should not be a subject of regret, but in the mining districts, where the coal owners are the largest ratepayers, they have little or no control over the local rates. Unless something can be done to stop wasteful expenditures, it is likely to be a most serious charge upon the coal mining of the country. The Workmen's Compensation Act and the working of deeper or thinner seams have also increased expenditure. On the other hand economies have been possible, due to improved appliances. In other parts of Europe there is also a tendency towards increased cost of production. In the case of Germany, our chief European competitor, the railway and canal rates are, however, much below those of this country. In America the cost of producing coal is below that of Great Britain, and is likely to be still lower. This is due chiefly to large areas near the outcrop, which do not need pumping or winding ; in fact, the United States are much in the position Great Britain was 50 or 60 years ago. The output of coal in the United States is increasing rapidly. In 1883 it was 102,868,000 tons; in 1896 it was 171,416,000 tons. For many centuries America will probably maintain a comparatively low cost of working, owing to the enormous extent of outcrop. The American coal fields are generally distant from the seaboard, but carriage is very low. In China enormous coal fields are believed to exist, and there is said to be large deposits of coal in Formosa. These, the author says, may ultimately shut out the whole of the Eastern markets.

The question of carriage, both in regard to the United States and Germany, brought forward the point on which the chief part of the discussion turned, namely, the State ownership of railways. In 1891 the author proposed, and he now repeats the suggestion with greater emphasis, "that the nation should take the necessary steps now, when it is practicable, to acquire the reversion of railways and docks, to enable the cost of railway carriage for minerals, goods and passengers, and of dock dues, to be ultimately reduced, if required, to the bare cost of working." If capital invested in public works were also repaid, the cost of living would be greatly reduced, and with it the rates for labor, thus making the United Kingdom, with its temperate climate, one of the most economical and pleasant of residential countries in the world. On the other hand, if the nation will do nothing to guard against the danger of commercial collapse, which will take place upon the exhaustion of our cheaply worked coal, we shall be in the position of being saddled with the large amount of capital invested in railway docks and public works, amounting at the present to 1,500 millions sterling ; the cost of manufacture will rise, and Great Britain must gradually sink into the position of a secondary power.

The discussion on this paper was opened by Mr. Jeremiah Head, who referred to certain suggestions that had been made for planting timber in order that it might take the place of coal as fuel. He had studied this subject in connection with an inquiry he had made about the possibility of establishing an iron industry in the Madras Presidency, where there were good supplies of iron ore, but where coal was lacking. Very moderate-sized furnaces would consume 5,000 tons of charcoal per year, and in order to supply this continuously, there would be needed an area of country represented by a circle 20 miles in diameter, it taking 30 years for the timber to form again when once cut down, so that one-thirtieth of the area would be denuded yearly. Such figures showed the impossibility of using timber for fuel. The author had very properly said that the United States was the country from whose competition we had most to fear. During the late strike in the coal trade, steamers were readily supplied with American coal, and it was a regular thing for bunker coal to be of American production. The Virginian coal was considerably cheaper at the pit than in this country. Not much coal had yet been brought across the Atlantic to us, but still our trade suffered from American competition, inasmuch as the cheap coal of the Uniten States enabled iron and steel makers there to produce at a low rate and successfully oppose us in what was once almost exclusively our market.

Last year 90,000 tons of American pig iron came over here, and 30,000 to 40,000 tons of steel. This could only be done by the aid of cheap fuel. The author had supported the Government acquisition of railways. No doubt one of the reasons America was able to meet us successfully in commercial rivalry was the low railway freights that ruled in the States. Coal was there carried at one-sixth of a penny per ton mile ; in this country it was from ½d. to 1d. per ton mile. These rates made it very difficult for the British manufacturer. No doubt much of the cheapness of American coal was due to natural advantages. The deposits were mostly well above water level, and cropped out on the hill sides, so that often neither pumping nor winding were needed ; whilst the seams were easy to work, being 4 feet to 12 feet thick. On the other hand, they were a long distance from the coast, but here, again, cheap carriage came in. In America trucks or cars were used carrying 40 tons each ; with us the trucks hold only 8 tons. The American locomotives and tenders were heavier than in this country, weighing 140 tons, as against ours of 90 tons ; and so as not to unduly press on the rails they had more wheels coupled. This resulted in the American locomotives hauling about twice as much as ours would. There, too, the freight cars had all automatic brakes, so that a high speed could be attained without fear of results. That was an advance that had not been introduced, the speaker believed, in the mineral traffic of this country. Mr. Head had made certain calculations in regard to the possibility of constructing a paying railway direct from the Yorkshire coal fields to London. It was not to be used for passenger traffic at all, and therefore would not need the expensive precautions that were demanded where trains full of people had to be considered. If the cost of land were not to be excessive, and wasteful expenditure in promotion and Parliamentary expenses were to be avoided, such a line could be established on a successful commercial basis, even were the carriage on coal reduced to one-half that at present charged. The speaker had previously considered that the institution of State railways was not the right thing for this country, but when he considered what should be the reduction of rates, and the little chance there was that the managers of commercial companies would be able to make these reductions, he was inclined to look favorably on proposals pointing in this direction. If the Government took the control of railways they might be worked in the interests of the trade and commerce of the country, in place of being operated upon the necessarily more short-sighted interests of present proprietors—of which, he might add, he was one.

Professor Louis, of Newcastle, followed Mr. Head, and agreed that mechanical methods should receive the first consideration. In Iowa, where he had been, 50 per cent. of the coal was cut by machinery, and it was found that in this way 30 per cent. more work was done per man employed than was effected in this country. That indicated how output might be cheapened. He referred to the reheating of air, before being used in a motor, by means of an electric resistance ; and, in regard to the use of electricity generally in coal mines, he considered that the danger had been greatly overrated. Experiments made in Germany had proved this, and with polyphase currents it was found that work could be done in mines with safety. In Hungarian mines

haulage is carried on by the trolley system with electrical locomotives. He did not believe in the advisability of compound winding engines, as the advantages of the compound system were not manifest in cases where the working was intermittent, and the engine had to be stopped and started at short intervals. Statistics of working bore this out. The deepest mines in the world were the copper mines of the Lake Superior district, and here a light pulley was used in place of a drum, the inertia of the latter in stopping and starting being a disadvantage. In ventilating mines he considered the method of forcing air in, rather than drawing it out by suction, was an advantage, as the cooling due to expansion was thus obtained, and was very effective. This fact was apparent in the case of the exhaust from pneumatic drilling machines. From personal experience he could bear out what the author had said about foreign competion. In Tonquin there were seams of coal 100 feet thick, with an outcrop of four or five miles. These were situated on an arm of the sea, and in addition to this, labor was about one tenth of what it is in this country. It was a most important thing to economize the good and more easily accessible coal still remaining; but we were now using it in a most wasteful way. As an instance, he would mention that the combustible gases from mines might be utilized.

Mr. Whittaker said there might be many more applications of scientific knowledge to the working of mines. For instance, the production of liquid air would have been looked on as a foolish dream a few years ago, but a practical use might be found for it before long. Speaking as a geologist he would expect a large extension of Bristol coal fields. In the past they had been extended, and he thought that in the future other deposits would be found. He was glad to see engineers were coming to recognize that railways should in some way be in the hands of the Government. Jevons had discussed the matter years ago, and now it was beginning to be seen that it was not altogether an impossible dream.

Mr. Hawksley protested against the latter view, and was emphatic in his condemnation of State aid. This country had reached its present position by virtue of the private enterprise of its citizens, and the intervention of Government in industrial undertakings would be fatal to progress. He thought that the principle of providing for future generations was apt to be carried to excess.

The President, Sir John Wolfe Barry, said that Sir W. Crookes in his address had pointed out the risk run through the falling off in wheat supplies, and now the author had uttered a warning no less emphatic in regard to coal. Sir Wm. Crookes had invoked the aid of the chemist; Mr. Brown had called on the engineer and political economist. There were two ways in which the falling off in coal might affect us. It might injure our export trade in that commodity, or it might make the manufacturing trade less remunerative. Already the supply of coal for steamers was not so exclusively in our hands as it was formerly, it being difficult for Welsh coal to hold the market further than Aden in the East, India and China both competing in this respect; America was in the field in the West. So far as engineering advance was concerned, other countries at once took up any improvements we introduced, but, as we worked more difficult seams, improved appliances were of more importance to us than to those countries where the coal was more accessible, and therefore mechanical appliances were of less moment. In discussing the question of railway rates, there was much to be said on both sides. In America they had long leads, and that naturally made the rate less; in fact, to make comparisons on the basis of coal per ton mile was illusory. In this way America had a natural advantage in regard to rates, though the total charge for haulage might be perhaps greater owing to the longer distances of the coal fields from the port of shipment. He agreed with what Mr. Head had said about a special mineral railway from the North to London. The question had been mooted 30 years ago, the rate proposed being ¼d. per ton per mile. The question the author had raised as to State railway ownership was one of extreme importance. He agreed with much that had been said in principle, but the practical question remained as to where the money should come from. Could any Chancellor of the Exchequer venture to add 1d. or 2d. to the income tax? for that was really what the proposal came to. The other alternative was that the railways should amortise themselves; but, again, shareholders would not sacrifice dividends for a distant future benefit, even if the benefit were acknowledged. He was afraid no one took a wide enough view to look so far ahead. He did not put much faith in Government management, and was of opinion that shareholders must take care of themselves. If it would kill the trade to pay ¼d. per ton for carriage the railways would have to be content with ¼d. per ton, and in this connection he would say that the lowering of charges was not necessarily fatal to prosperity for shareholders. In the case of the Barry Dock Railway they had been compelled by competition to charge considerably less than had been anticipated. The result had been an enormous development of the volume of freight, and the company, in spite of low charges, had been able to pay 10 per cent. ever since.

The author, in replying to the discussion, said he could not concur in the use of electric locomotives in deep mines, which were generally gaseous. In advocating compound winding engines he spoke from experience, which showed him there was no difficulty in stopping and starting. It had been said that an increase in coal economy, that is, a larger proportion of power obtained from a given consumption of fuel, would lead to less coal being needed. The reverse had been found to be the case, for the possible demands for power being unlimited the cheaper the cost of mechanical power the more it would be utilised, and that would outbalance the reduction in the coal consumed per unit of power. Mr. Hawksley had objected to State controlled railways, as it would tend to hamper and restrict enterprise. The speaker agreed so far as the formation of new undertakings was concerned, but when the railways were once formed the same reasoning would not apply, and he considered we had now reached a point when the change should be made. If the making of provision for the future were left to the shareholders he was of opinion that they would say, "Let us keep up the rates," and they would only recognise the need of a reduction when the trade was gone. It was the duty of the State to foresee and provide for such events as he had foreshadowed. We were not living on our capital, and it was not unreasonable to take something from this to make a provision for the future. He did not claim to suggest the best plan. The true solution of the problem might be different to that which he suggested, but it was the duty of the Government to take the matter into consideration. Speaking of home manufactures, he would point out that our success depended on cheap raw material, and this in turn was largely due to the fact that our ships carried outward cargoes of coal, which acted as ballast, and, therefore, could bring back produce at a low freight.

Specialism in Engineering.

Engineering Record says that specialism in engineering is now so well recognized by the practicing members of the profession that anything written on the subject for them particularly would be of little importance. But young men, graduates and undergraduates, may very well pay some attention to what is meant by this term, so characteristic of the present time, particularly as a correct appreciation of the proper mental training of an engineer is grasped with difficulty by those on the lower rounds of the ladder of success, who are naturally interested in every branch of their work. It does not take long for an energetic, capable young man to find a position where his duties are congenial, and, if he is one of those who achieve success, he spends a portion of his spare hours in study. It is at this stage of his career that he may lose much valuable time through failure to recognize the vast amount of detail knowledge required for success in any one branch of engineering, and fritter away his time in a fruitless attempt to keep track of the current progress in every branch. The quicker he drops such an attempt the better for him. Progress nowadays is due to careful attention to details, seemingly trivial in themselves, but collectively of importance. Anyone who will put in a portion of his spare time in following the details of his specialty will find himself well occupied.

As engineering, however, is but the application of scientific knowledge for definite purposes in the manner experience indicates as best calculated to give the desired results, it follows that the scientific knowledge of the engineer is very important. It is the belief of the *Engineering Record* that the young man who wishes to become a specialist in power plant design and operation, in municipal engineering or in structural work, will waste his time if he tries to keep in touch with gold mining, the design of naval vessels, or the management of locomotives; on the other hand, increased knowledge of mathematics, hydraulics and hydromechanics, thermodynamics, the elasticity of materials, biology, chemistry and other branches of science will be of distinct advantage. Such studies train and broaden the mind and strengthen the mental foundation on which the chosen specialty rests. The opposite course simply overloads the superstructure with trimming hastily obtained, hardly ornamental and certainly of little use.

The specialist, moreover, comes in contact in a business way with all sorts and conditions of men who do not know the difference between a sine and a shackle bolt, and do not care what it is. He must convince these men that his recommendations are for their good, and to do this successfully he must be a specialist in another subject neglected by most engineers, the English language. Unless he can express his opinions

and the reasons for them so clearly and forcibly that a man of ordinary ability can understand them fully, his professional attainments will not receive the consideration due them. Therefore the earnest recommendation is made to all young engineers that they devote a part of their time to becoming familiar with the resources of our language and to acquiring facility in describing technical subjects in a non-technical manner. A study of good literature and practice in writing intelligible descriptions of engineering works without reference to illustrations will be a training of more value than it is possible for a young man to appreciate. If this facility in the use of words is acquired early it will not be lost, but to gain it in later years is as difficult a task as one could set for his bitterest enemy.

Pneumatic Riveters for Tank Work.

The *Am. Mfr.* says that an interesting application of pneumatic riveting machines to heavy tank work is now being made at Washington, D. C., where a gasholder 175 feet in diameter is being erected for the Washington Gas Company by the Stacy Manufacturing Company, of Cincinnati. This tank will consist of four telescopic sections, each 35 feet deep. The lower section has $\frac{5}{8}$-inch steel bottom plates, with side plates 1 inch thick and 6 feet wide, while the thickness of the plates of the upper sections is reduced toward the top. The rivets in the lower section are $1\frac{1}{8}$, $1\frac{1}{4}$ and 1-inch in diameter and $\frac{3}{4}$-inch rivets are used in the other sections.

All the riveting is done by 8-yoke riveters, having a reach of 6 feet, which were built by the Chicago Pneumatic Tool Company. These consist of a yoke frame made of plates and angles, upon which are mounted heavy pneumatic hammers of the Boyer type. Four of these hammers have a $1\frac{3}{4}$ inch piston and a stroke of 6 inches, while each of the others has a piston $1\frac{5}{16}$ inches in diameter and a 5-inch stroke. Each riveter is suspended by a block and tackle from the top of a traveler along which it can be moved through a distance of about 12 feet. The traveler is supported by rollers which run on the upper edge of the side plates, and the frame is held in any position by wedges driven between the upright posts and the tank plates. The whole forms a very convenient arrangement, which can quickly be moved from one point to another.

Compressed air is furnished at a pressure of 100 pounds per square inch by a compressor run by steam from the boiler of the hoisting plant. Two men are required to tend each riveter, and we are told that these two men can do the work of about nine hand riveters. In one day, of 10 hours, 530 $1\frac{1}{4}$-inch rivets were driven with one machine, and 700 $\frac{3}{4}$-inch rivets is not an extraordinary day's work.

Artificial Vanillin and Vanilla Flavors.

Recently considerable excitement was aroused in Vienna, Austria, by the fact that a number of seemingly most mysterious cases of poisoning—and not a few fatalities—were traced to the use of ices and confections purportedly flavored with vanilla. But why the vanilla alone should be at fault is a pertinent query, since this was the verdict brought about by the investigation.

That the vanilla bean is in a measure toxic, if ingested in large quantities, no one familiar with this growth will deny; but any amount that could induce an untoward effect must necessarily be so great that it could not, by any possibility, be embodied in gallons of ices or a hundredweight of confections. Again, though the bean produces a malady in those handling it known as the "vanilla disease"—a form of skin eruption that, while it may be communicated to others, is necessarily self-limited—this can have nothing to do with poisoning with vanilla "flavors," since its source is a minute insect, the "vanilla louse," of the same precise class as the cheese mite, and its period of life is extremely brief when transfered to the integuments of human beings.

Also worthy of being recalled is the fact, admitted even by those most interested in their production, that vanilla "flavors," vanilla "extracts," vanilla "essences" and "tinctures," such as are employed solely to promote *saveur* or piquancy, are never absolutely pure; on the contrary, for the most part, they are made with tonka bean alone, or with tonka to which from 5 to 20 per cent. of vanilla bean is added. The high prices the latter command, and which oftentimes are actually prohibitory, are cited as an excuse for the deception; further, it is added, the mixture secures a better flavor, one preferred for domestic, culinary and confectionery purposes. In this connection it may be remarked that while so-called "fruit flavors," employed in kitchens, confectionery establishments, bake shops and at soda fountains, are almost invariably derived from butyric ether—a product of rancidity—this accusation does not hold good as regards vanilla preparations.

But even tonka beans are at times expensive, and recently they, as well as vanilla, have been replaced, in the manufacture of flavors, by vanillin. This latter is the active principle of both vanilla and tonka beans, but if had from this source, would manifestly serve to still further increase the cost of "extract" production. It has been had also from coal tar by process of synthesis, but this again was held insufficiently economical, or it was feared the knowledge that a flavor owed its origin to an anilin factory would militate against it as a marketable product. Now vanillin is purportedly derived from the inner rind of the bark of certain pine and fir trees, by the aid of sulphuric acid and either sodium or potassium chromate, the process being somewhat intricate, secret and legally protected. It is likewise (and perhaps more commonly, certainly more economically) had from oleaginous, gummy and balsamic substances that are possessed of an aromatic, stereoptin constituent known as cardol; and it is the latter upon which the burden of reproach is supposed to rest—a supposition that does not appear to be well founded.

Cardol is certainly highly toxic; so is hydrocyanic (prussic) acid, to which our most delicious fruits owe their flavor. Cardol is found, but only in infinitesimal quantities, in most forms of vegetable growth, the only fruit yielding it in fairly tangible proportions being the "elephant louse" (Anacardium orientale) of the far East; and while it is highly poisonous when injected into the circulation, and most irritating when applied to the skin, producing a painful burning eruption, attended with considerable swelling and infiltration of serum (cellulitis), it is known to be inactive when taken into the stomach, being insoluble in any of the digestive secretions. Manifestly, then, cardol cannot be deemed a factor in vanilla poisoning, unless it can be shown: First, that it is present in artificial vanillin in appreciable quantities; second, that in the manufacture of vanillin certain chemical transformations result whereby a cardol combination of free and ready solubility is had.

The remarkable part of the Vienna investigation lies in the fact that no evidence is offered to show that the constituents of the ices and confections other than the vanilla flavoring were investigated. Considering the number of fatalities, an examination for developed and contained ptomaines, or for anilin coloring matters, would seem to have been demanded. At the same time, more knowledge regarding artificial vanillin is desirable.

Lubricants for Glass Stopcocks.

[By Mr. F. C. Phillips, in *Jour. Am. Chem. Soc.*]

The success of modern chemical research work depends frequently upon the maintenance in position for considerable periods of complex forms of apparatus in which glass stopcocks play an important part, and the failure or breakage of a stopcock often proves to be the cause of serious loss of time or material. The efficiency of a stopcock is, however, quite as much dependent upon the lubricant used for its protection as upon the skilful workmanship of the glass blower in its manufacture.

It has been the common practice to employ an animal fat or a mixture of such fats for lubricating the stopcock plugs of apparatus of all kinds and for work of every description, although it is a fact of experience that such lubricants are often a source of inconvenience and even danger to the apparatus.

A stopcock lubricant should, besides overcoming friction, satisfy the following requirements:

1. It should adhere to the glass and should not be loosened by water.
2. It should be little affected by changes of temperature.
3. It should not be saponified by alkali.
4. It should be sufficiently transparent or translucent to render visible any clogging of the hole in the stopcock plug while in use, and to show whether air spaces occur between the plug and the walls of the stopcock.

Ordinary fats are so easily saponified and adhere so feebly to glass that they are seldom suited to the purpose. Pure rubber heated to a temperature sufficient to render it permanently viscid, has advantages over fats, but its adhesiveness is lessened by moisture, and it is completely removed by alkali.

Schmitz recommends for glass stopcocks the use of guttapercha dissolved in a high-boiling mineral oil. This mixture, although not saponifiable, does not adhere well to glass. If thinned down suffi-

ciently with oil, its lubricating qualities suffer, while the guttapercha tends to become granular if the mixture is made thicker.

Vaseline, which is sometimes recommended for use alone, does not adhere to the glass, and does not overcome friction.

With a view to producing a lubricant better adapted to use on glass stopcocks, a series of experiments has been tried. Various mixtures of softened rubber with other substances were tested. On mixing together

Pure rubber	70 parts.
Spermaceti	25 "
Vaseline	5 "

a mass is obtained which lubricates well, is translucent, adheres to the glass, and is not saponifiable. The vaseline was added to the mixture to increase its softness. The materials were thoroughly mixed while hot, the rubber being melted first and the others stirred in. It is well to use a little more vaseline in winter than in summer.

Another preparation, which gave still better results, was made by mixing

Pure rubber	70 parts.
Yellow unbleached beeswax	30 "

The rubber should be pure and fresh. Old rubber, or scraps of worn-out tubing, whether black or red, will not answer as well, and may cause the mixture to become more or less granular and opaque when used in the stopcocks. The rubber is best heated in a covered vessel until thoroughly melted, and then the wax should be added. The hot mixture is well stirred. No vaseline is needed. This lubricant is very serviceable, protects stopcocks from sticking, even when used for concentrated solutions of caustic alkalies, and is quite translucent in thin layers. Care should be used not to scorch the mixture in its preparation. Strong alkalies tend in time to loosen and emulsify all lubricants and the stopcocks should occasionally be cleaned and recoated.

It has been attempted to increase the adhesiveness of such lubricants by the addition of small quantities of balsam of fir and other strongly adhesive substances, but difficulty was found from the tendency to cause sticking of the stopcock plug. The rubber mixtures should not be exposed to the air longer than is necessary during the heating, and they should be preserved in closed bottles.

Various mixtures of gutta percha with wax and with oils were tried but the gutta percha tends to cause granulation and diminishes adhesiveness. The mixtures above recommended may be readily removed from parts of glass apparatus which are difficult of access for cleaning, by the use of a little concentrated nitric acid, which quickly attacks and loosens it so that it may be washed out by water.

No lubricant is fit for use unless it renders the stopcock nearly or quite translucent, so as to show whether or not the plug is coated over its entire length.

A thick rubber and wax mixture is especially suited for well ground glass stopcocks upon gas vessels which are to be exhausted and which have therefore to sustain the full pressure of the atmosphere. Such mixtures have been in use for stopcocks of ordinary burettes in volumetric work during about two years and have given satisfactory results in every way.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. James Somerville, Engineer and Superintendent of the Indianapolis (Ind.) Gas Company, writing to the Journal under date of September 21st, says:

To the Editors American Gas Light Journal: Allow me to call your attention to what might become a serious misprint, which occurs in the article headed "Modern Appliances for the Recovery of By-Products from Coking Coal," issue of September 19th, page 415. It is this: "The heating value of 84,700 cubic feet of such gas corresponds to that of about 21 tons of coal." It ought to have been 847,000 cubic feet. It would have added to the value of the article if the author had given an analysis of the gas after its oil bath, so that one could have ascertained its heating power. I have an idea that after it had been freed from its benzol the heating power would be considerably reduced, and that 50,000 cubic feet to equal 1 ton of coal would be nearer the mark.

Messrs. Holmes, Booth & Haydens, of Waterbury, Conn., are making extensive repairs and additions to their plant. The Berlin Iron Bridge Company, of East Berlin, Conn., has secured the contract for the steel roof for the boiler room, 40 by 80 feet; the new muffle room, 35 by 80 feet; and the new brass mill, 118 by 90 feet. These additions are to be fireproof throughout. The side walls are of brick, the roof supports are of steel, and the covering of corrugated iron. The roofs are arranged with skylights for lighting the interior of the building and monitors for ventilation.

The authorities of Galt, Ontario, as the result of a special election, have been instructed to take over the gas and electric lighting plants of the Galt Gas Light Company, for operation on municipal account.

The regular dividend of $1 per share on the stock of the Providence (R. I.) Gas Company is payable on demand.

The Syracuse (N. Y.) *Standard* is our authority for the statement that the Attica (N. Y.) Electric Light Company has closed up its business, owing to the largely increased use of gas in the named village.

Mr. J. H. Miller, of McKeesport, Pa., has leased the plant of the Shippensburg (Pa.) Gas Company. He proposes to make several improvements on the property.

Application has been made for a receiver for the Peoples Gas Light Company, of Crestline, Ohio.

Advices from Chicago are to the effect that some idea of the great increase in the sales of fuel gas by the Peoples Gas Light and Coke Company can be gathered from a statement showing the wonderful increase in the use of gas ranges. The Company, through its appliance department, so far has put into homes about twice as many new gas ranges as it did during the first eight months of 1897. Since April 1st this year, up to September 16th, the Company had disposed of 16,000 gas ranges. As many as 200 have been sold and set up in a single day. A large number of teams are kept constantly busy delivering the ranges.

"T. D. W.," writing from Staunton, Va., under date of September 27th, says: "I note your reference in the Journal to the incorporation of the New City Gas Company, of West Virginia, and herewith forward you a copy of the charter under which it is organized."

The charter reads: "The undersigned agree to become a corporation by the name of New City Gas Company, for the purpose of building, erecting, buying, leasing, acquiring, maintaining and operating gas works, electric light works and street and tram railways, to be operated by electric or other motive power, with authority to do and perform all acts necessary to the full and free exercise of the purposes above indicated, including the right to purchase the stock, plants and franchises of other corporations chartered for similar purposes and to consolidate and operate the same. Which corporation shall keep its principal office or place of business at Staunton, in the county of Augusta, in the State of Virginia, and is to expire on the 26th day of May, in the year 1948. And for the purpose of forming the said corporation, we have subscribed the sum of $100,000 to the capital thereof, and have paid in on said subscriptions the sum of $10,000, and desire the privilege of increasing the said capital by the sale of additional shares from time to time, to $200,000 in all. The capital so subscribed is divided into shares of $100 each, which are held by the undersigned, respectively as follows, that is to say, by: R. D. Apperson, of Staunton, Va., 10 shares; R. D. McCue, of Staunton, Va., 2 shares; Henry Marquand, New York city, 60 shares; Lewis C. Harris, of Forest Hill, N. J., 13 shares; F. B. Poor, Hackensack, N. J., 15 shares. And the capital to be hereafter sold is divided into shares of the like amount."

Mr. Gideon Fordham, for many years Lessee and Superintendent of the Le Roy (N. Y.) Gas Light Company, died at his home in Le Roy the evening of September 22d. Deceased was born in Le Roy, May 12th, 1830, and his complete career was concerned in the business matters of his birthplace.

Mr. Charles E. White, of Philadelphia, has been appointed Manager of the municipal gas and electric light plants of Wakefield, Mass.

The Welsbach Street Lighting Company of America is arranging with the Adams (Mass.) Gas Company for a good working example of street lighting by means of incandescent gas lamps in Adams.

Welsbach lamps, to the number of 117, have been contracted for in the public lighting system of Somerville, Mass.

AT the annual meeting of the Lewiston (Me.) Gas Company the following officers were chosen: Directors, W. H. White, Seth M. Carter, Edward C. Lee, Samuel T. Bodine and Randall Morgan; Treasurer, Edward C. Lee; Clerk, Wm. R. Stevens.

THE new net rate for gas at Lexington, Mass., is $2.50 per 1,000 cubic feet.

"ABOUT a fortnight ago those interested in the formation of the Winchester (Mass.) Gas Light Company effected a temporary organization by naming Mr. F. D. Lesure to the Presidency and Mr. W. O. Smith was elected Clerk. The Company is composed of local merchants, and they propose to supply acetylene gas from a central station.—F. R."

THE improvements on the plant at Champaign, Ills., have been completed. The main item of the new construction is a storage holder.

THERE is some talk of forming a gas company to operate in Nauvoo, Ills.

THE extremely light rains during the current "wet season" in California have caused much trouble to the owners of electric plants dependent upon water power for their operation.

IN an editorial in the Trenton (N. J.) *Gazette*, which had for its inspiration the gas war in that city, referring to Mr. Wilder F. Lawrence, who is in charge of the works of the old Company, we find the following: "Mr. Lawrence is a man of experience in gas manufacture. He is a graduate of the Stevens Institute of Technology and received his practical insight into gas making under Mr. C. H. Nettleton, ex-President of the American Gas Light Association, who is conceded to be one of the leading authorities in the world on gas."

MR. F. H. EICHBAUM, writing to the JOURNAL from San Francisco, under date of September 20th, says:

To the Editors AMERICAN GAS LIGHT JOURNAL: I send you a clipping from the San Francisco *Call*, dated September 18th, which clipping I think shows that "Dr." Chisholm could give points to Baron Munchausen. The Kalamazoo works were shut down January 3, 1898, and have not been resurrected up to this date. The concern was, according to the JOURNAL of comparatively recent date, advertised as about to be foreclosed for a debt. While the Kalamazoo plant was running the gas produced was of very low illuminating value (about 6 or 8 candles), which few of the residents cared to use, and it could only be used with any satisfaction in Welsbach burners. "Dr." C.'s explanation of the water in the drips will go down with King George's mystery of how the apple got into the dumpling. It would be interesting to know the current whereabouts of the 1,000,000 cubic foot plant that was built and rebuilt 19 times, as but 5 attempts and failures are recorded in current news. Where was this plant? The attributes of his gas, if correctly stated, are nearly those of air, which constitutes 62 per cent. of the article, which is to be first tried on the Chinese—if they like it, then on the white residents of San Francisco. Hall seems to be thrown into the shade by "Dr." Chisholm. Gas is holding its own well in San Francisco.

THE clipping forwarded by Mr. Eichbaum is as follows: "When Professor T. S. C. Lowe, who has since become famous as the builder of the Pasadena Mountain Railway, introduced the monoxide called water gas as a superior and cheaper fuel than coal gas, there shortly followed a great change in the gas world upon the subject of the manufacture of this product. Professor Lowe's theory was at variance with and was a great improvement over that of the coal gas; through its application there resulted an entirely new product called water gas. One physical characteristic of water gas, however, is that, under the influence of pressure, friction or low temperature it will deposit much of its hydrogen in the form of water, and this has to be pumped out of the drips along the lines by which it is transmitted to the consumers. This loss aggregates about 40 per cent. of the total bulk of the manufactured product. It costs the California Companies about 78 cents to manufacture gas. But a gas which is a fixed gas, in that it is homogeneous, elastic, does not condense under pressure or friction, and has successfully stood the test of temperature as low as 45° below zero, and, moreover, a gas which costs in its manufacture less than 10 cents per 1,000 cubic feet, and, in places where fuel is cheap, as low as 5 cents per 1,000 cubic feet, which burns with intense heat, its heat units being equal to those of natural gas and greater than those of water gas, has at last been invented, and a factory for its manufacture is at the present time undergoing construction in San Francisco. A small and somewhat experimental plant has for the past 10 months been in existence in Kalamazoo, Michigan, and has, during that period, been supplying that town. Such a gas, it may be expected, is destined to revolutionize the whole of the industry. Its appearance in the industrial world is without doubt the greatest event since the application of steam to power purposes. For years the gas world looked for the coming of a gas which would do away with the use of coal as fuel; thousands of attempts were made to solve the problem, but, none succeeding, the belief came to crystallize that such a gas was not possible of production, and that a cheap gas must necessarily be a poor gas. The inventor of this process for making gas is Thurston Gordon Hall, a gentleman whose struggle to get his idea upon its feet has been a life long one. Seven years ago he met Dr. J. W. Chisholm, a capitalist of Chicago, who had been operating in electrical works, and after much effort finally succeeded in enlisting him to take hold of his project. The invention at that time was in the shape of a broad idea in the mind of Dr. Hall, but the two went to work upon it. Dr. Chisholm spent hundreds of thousands of dollars before the process was fully evolved. The product was such that the tests could not be made in a laboratory, but a regular working plant had to be built in which to conduct them. The smallest apparatus which Dr. Chisholm ever used had a capacity of 1,000,000 cubic feet per day; and one of these he built and tore down in all 19 times. The plant now being erected is on the site of the old Selby smelter, on Beach street, between Hyde and Leavenworth streets. The completed plant will cost $2,000,000, and will have a capacity of 20,000,000 cubic feet per day. Gas will first be furnished to the district of the city comprising Stockton, Post, Sutter and Montgomery streets, and the locality generally bounded on the north and east by the Bay of San Francisco, on the west by Van Ness avenue and on the south by Market street. Gas will be furnished consumers at $1 per 1,000 cubic feet. The stock has been pooled for five years, with an agreement not to increase the price of gas beyond that rate."

ADVICES from Memphis, Tenn., relate that the question of consolidation of the Gas Companies of that city is now before the Council. It was brought up when it was proposed to make a contract with the Equitable and New Memphis Companies whereby consolidation could be accomplished. The contract would put a stop to the litigation now in progress between the city and the Equitable Company, whereby the city is seeking to recover $50,000 liquidated damages for violation of the Equitable's contract by alleged consolidation with the New Memphis Company, it being contended by the city that a virtual consolidation has been effected. In consideration for formal permission to consolidate the Companies propose to furnish illuminating gas at $1.50 per 1,000, and fuel gas at $1.25 per 1,000, until the annual sales shall reach 110,000,000 cubic feet, when the prices shall be reduced 5 cents, and thereafter a reduction shall follow as the sales increase, until a rate of $1 per 1,000 shall be reached, on a basis of 200,000,000 cubic feet per annum. In addition to other considerations, the Companies agree to furnish $50,000 worth of gas to the city, one tenth to be furnished annually for 10 years, at $15.75 for each lamp post per annum. The Companies agree to keep the lamp posts in condition and to light the street lamps; and to private consumers they will furnish correct meters and make credits for any excess of gas beyond 2 per cent., as shown by fast meters, as declared by inspectors to be selected by the city.

THE exact scale of prices to be charged, as the output of the Memphis Companies expand, is appended:

Annual Output, Cu. Ft.	Illuminating Use.	Fuel Use.
Up to 110,000,000	$1.50	$1.25
110,000,000	1.45	1.20
120,000,000	1.40	1.15
130,000,000	1.35	1.10
140,000,000	1.30	1.05
150,000,000	1.25	1.00
160,000,000	1.20	1.00
170,000,000	1.15	1.00
180,000,000	1.10	1.00
190,000,000	1.00	1.00

When the price of gas has been reduced as above stated to $1, there shall be no further reduction in prices, but thereafter the Company agrees to furnish for lighting public buildings of the city, free of cost to the city, gas to the amount of $1,000 per annum. All gas bills shall be paid by the consumers within the first six days of the month for which the bill is rendered; and, if not paid within that time, an additional charge of 25 cents per 1,000 cubic feet may be added by the Gas Company.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,

PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,

EDITORS.

CHAS. E. SANDERSON,

MANAGER.

MONDAY, OCT. 3, 1898.

The Market for Gas Securities.

Prices for city gas shares show marked declines over the figures of last week. Consolidated sold at 178, and at noon to day (Friday) the quotation was 178½ to 178⅝. Amsterdam's, "common to fancy," were respectively 26½ to 28, and 65 to 67. Standard securities are notably dull and lower. The common is offered at 133, at which price it is very cheap; the preferred is offered at 153. Mutual is steady at the figures of last week. A feature of the lighting situation in New York just now is the revised rate schedule of the Edison Electric Illuminating Company. The scale in the schedule shows how the gas companies have been oxidizing the business of the Electric Company.

Brooklyn Union is remarkably strong, in face of the adverse gas situation in the Borough of Manhattan. Those in the know say that the Brooklyn Company is earning not far from 9 per cent. Peoples of Chicago is lower, Baltimore Consolidated is a bit weaker, and Bay State seems palsied. It was hoped that the recent change in the domestic relations of Mr. Addicks would help the stock, but the hope was vain. Anything on the list looks a purchase, particularly Columbus (O.) gas, which should be at par.

Gas Stocks.

Quotations by Frederic B. Cochran & Co., Brokers and Dealers in Gas Stocks.

20 AND 22 BROAD STREET, NEW YORK CITY.

OCT. 3.

☞ All communications will receive particular attention

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$37,730,000	100	178¾	..
Cental Union, Bonds, 5's	3,000,000	1,000	101	101⅛
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	320	330
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.	13,000,000	100	26½	28
Preferred	10,000,000	100	65	67
Bonds, 5's	11,000,000	1,000	99¾	100¼
Northern Union, Bonds, 5's	1,250,000	1,000	94½	95½
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	111	113
" 1st Con. 5's	1,500,000		107½	108½
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	130	133
Preferred	5,000,000	100	145	153
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	125½	..
" " Bonds (5's)	15 000,000	1,000	115	115½
Bay State	50,000,000	50	3	3⅛
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works..	450,000	100	..	..
" 1st Mtg. 5's	450,000	1,000	..	..
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	..	80
Buffalo City Gas Co.	5,500,000	100	20	20½
" " Bonds, 5's	5,250,000	1,000	95½	96½
Central, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,144,700	100	80	91
1st Mortgage	1,207,000	1,000	101	103½
Consumers. Jersey City	2,000,000	100	78	85
" Bonds	600,000	1,000	101½	103½
Cincinnati G. & C. Co.	8,500,000	100	201¾	202
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	64	64½
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	..
Consolidated Gas Co. of N.J.	1,000,000	100	16	21
" Con. Mtg. 5's	380,000	1,000	75	80
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,500,000	50	65	65½
" Prior Lien 5's	4,538,000	1,000	94¼	94½
Detroit Gas Co., 5's	428,000	1,000	..	..
" Inc. 5's	84,000	100	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wa	2,000,000	..	75	80
" Bonds	2,000,000	..	88	
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	.
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	115	125
" Bonds, 6's	2 650,000	..	106	107
Jackson Gas Co.	250,000	50	..	..
" 1st Mtg. 5's	250,000	1,000	..	..
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	78	88
Bonds	1,000,000	1,000	90	91
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	48¾	49
Preferred	2,500,000	100	92	..
Bonds	10,000,000	1,000	105	105¼
Madison Gas & Elec. Co.	400,000	100	..	..
" 1st Mtg. 6's	350,000	1,000	..	..
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	252	..
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	52	53
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	103¾	103
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	83	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	85⅝	86
St. Paul Gas Light Co.	1,500,000	100	49	51
1st Mortgage 6's	650,000	1,000	84	87
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	80	82
St. Joseph Gas Co.	1,000,000	100	..	..
" 1st Mtg. 5's	750,000	1,000	..	..
Syracuse, N. Y.	1,750,000	100	17	18
Bonds	1,500,000	1,000	94	97
Washington, D. C	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	85¼	86
Bonds, 5's	3,556,000	.	101¾	102½
Wilmington, Del.	550,000		204	206

Advertisers' Index.

GAS ENGINEERS.

	Page
Wm. Henry White, New York City	515
Fred. Bredel, Milwaukee, Wis.	501
Geo. R. Rowland, New York City	515
The Western Gas Construction Co., Fort Wayne, Ind.	504
Humphreys & Glasgow, New York City	508
American Gas Co., Phila., Pa.	502
David Leavitt Hough, New York City	517
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	515
Baxter & Lynn, Detroit, Mich.	499

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md.	513
United Gas Improvement Co., Phila., Pa.	507
Burdett Loomis, Hartford, Conn.	514
National Gas and Water Co., Chicago, Ills.	509
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	515
The Western Gas Construction Co., Fort Wayne, Ind.	504
Humphreys & Glasgow, New York City	508

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd's Sons, New York City	516
Continental Iron Works, Brooklyn, N. Y.	514
Deily & Fowler, Phila., Pa.	516
Kerr Murray Mfg. Co., Fort Wayne, Ind	512
Stacey Mfg. Co., Cincinnati, Ohio	515
Bartlett, Hayward & Co., Baltimore, Md.	513
Davis and Farnum Mfg. Co., Waltham, Mass.	512
R. D. Wood & Co., Phila., Pa.	514
Isbell-Porter Company, New York City	514
Fred. Bredel, Milwaukee, Wis.	502
United Gas Improvement Co., Phila., Pa.	507
Berlin Iron Bridge Co., East Berlin, Conn.	501
National Gas and Water Co., Chicago, Ills.	509
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	515
The Western Gas Construction Co., Fort Wayne, Ind.	504
Humphreys & Glasgow, New York City	508
Gas Engineering Co., Pittsburgh, Pa.	512
American Gas Co., Phila., Pa.	502
Logan Iron Works, Brooklyn, N. Y.	516
Riter-Conley Co., Pittsburgh, Pa.	508
Baxter & Lynn, Detroit, Mich.	499

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City	515
R. D. Wood & Co., Phila., Pa.	414
James R. Floyd's Sons, New York City	516
Continental Iron Works, Brooklyn, N. Y.	514
Gas Engineering Co., Pittsburgh, Pa.	512
Logan Iron Works, Brooklyn, N. Y.	516
Riter-Conley Co., Pittsburgh, Pa.	508

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City	515
R. D. Wood & Co., Phila., Pa.	514

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich.	498
G. Shepard Page's Sons, New York City	515
Gas Engineering Co., Pittsburgh, Pa.	512

GAS METERS.

John J. Griffin & Co., Phila., Pa.	520
American Meter Co., New York and Philadelphia	519
Helme & McIlhenny, Phila., Pa.	519
D. McDonald & Co., Albany, N.Y.	517
Nathaniel Tufts Meter Co., Boston, Mass.	518
Maryland Meter and Mfg. Co., Baltimore, Md.	518
Metric Metal Co., Erie, Pa	518
Keystone Meter Co., Royersford, Pa.	518
Detroit Meter Company, Detroit, Mich.	519

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia	519
John J. Griffin & Co., Phila., Pa.	520
D. McDonald & Co., Albany, N. Y.	517
Helme & McIlhenny, Phila., Pa.	519

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio	517
M. J. Drummond & Co., New York City	517
R. D. Wood & Co., Phila., Pa.	514
Warren Foundry and Machine Co., New York City	517
Donaldson Iron Co., Emaus, Pa.	517
Utica Pipe Foundry Co., Utica, N. Y.	517

PIPE CUTTERS.

The Anderson Pipe Cutter Co., East Boston, Mass.	501

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y.	509

GAS COALS.

Penn Gas Coal Co., Phila., Pa.	511
Perkins & Co., New York City	510
Despard Gas Coal Co., Baltimore, Md.	511
Westmoreland Coal Co., Phila., Pa.	511
Berwind-White Coal Mining Co., New York and Phila.	510
W. D. Althouse & Co., Phila., Pa.	511

CANNEL COALS.

Perkins & Co., New York City	510
W. D. Althouse & Co., Phila., Pa.	511

GAS ENRICHERS.

Standard Oil Co., New York City	511
The Sun Oil Co., Pittsburgh, Pa.	511

COKE CRUSHER.

C. M. Keller, Columbus, Ind.	511

GAS GAUGES.

The Bristol Co., Waterbury, Conn.	499

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 509
Isbell-Porter Co., New York City 514
R. D. Wood & Co., Phila., Pa 514
Wm M. Crane Co., New York City 499

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N.Y. 500

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J. 500
B. Kreischer & Sons, New York City 500
Adam Weber, New York City 500
Laclede Firebrick Mfg. Co., St. Louis, Mo. 500
Cyrus Borgner, Phila., Pa. 500
James Gardner, Jr., Pittsburgh, Pa. 500
Henry Maurer & Son, New York City 500
Baltimore Retort and Firebrick Co., Baltimore, Md. 500
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. 500
Brooklyn Firebrick Works, Brooklyn, N. Y. 500
F. Behrend, New York City 501

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md. 513
Fred. Bredel, Milwaukee, Wis. 502
J. H. Gautier & Co., Jersey City, N. J. 500
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. 500
Adam Weber New York City 500

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City 514
Continental Iron Works, Brooklyn, N.Y. 514
G. Shepard Page's Sons, New York City 515
Logan Iron Works, Brooklyn, N. Y. 516
R. D. Wood & Co., Phila., Pa. 511

INCANDESCENT GAS LAMPS.

Welsbach Commercial Co., Phila., Pa. 506
Victor Incandescent Company, New York City 499

MICA GOODS.

The Mica Mfg. Co., New York City 498

BURNERS.

C. A. Gefrorer, Phila., Pa. 514
Wm. M. Crane Co., New York City. 499

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn. 498

STREET LAMPS.

Welsbach Street Lighting Co., New York and Phila. 508

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 509
Greenpoint Chemical Works, Brooklyn, N.Y. 509
Gas Purification and Chemical Co., Ltd., London 509

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind 508
Isbell-Porter Company, New York City 514
Connelly Iron Sponge and Governor Co., New York City 509

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y. 504
Chapman Valve Manufacturing Co., Boston, Mass. 504
R. D. Wood & Co., Phila., Pa. 514
Continental Iron Works, Brooklyn, N. Y. 514
The P. H. & F. M. Roots Co., Connersville, Ind. 508
Isbell-Porter Co., New York City 514
The Western Gas Construction Co., Fort Wayne Ind. 504

ELECTRICAL APPARATUS.

Wm. Henry White, New York City 515

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa. 484
Backus Water Motor Co., Newark, N. J. 462

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City 501
W. G. & G. Greenfield, East Newark, N. J. 462

PURIFIER SCREENS.

John Cabot, New York City 499

GAS STOVES.

American Meter Co., New York and Philadelphia 505
Maryland Meter and Manufacturing Co., Baltimore, Md. 518
Keystone Meter Co., Royersford, Pa. 518
Wm. M. Crane Co., New York City 499

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y. 504

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md. 513
Continental Iron Works, Brooklyn, N. Y. 514
Deily & Fowler, Philadelphia, Pa. 516
Davis & Farnum Mfg. Co., Waltham, Mass. 512
Kerr Murray Mfg. Co., Fort Wayne, Ind. 512
Stacey Mfg. Co., Cincinnati, Ohio 515
R. D. Wood & Co., Philadelphia, Pa. 514
Logan Iron Works, Brooklyn, N. Y. 516
Riter Conley Co., Pittsburgh, Pa. 508

BOOKS, ETC.

Scientific Books 510
Digest of Gas Cases 511
Practical Photometry 500
Gas Flow Computers 519
Hughes' "Gas Works" 509
Poole on Fuels 513
Gas Engineer's Pocket-Book 501

DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., DREXEL BUILDING, PHILA., PA., Sept. 22, 1898.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable on Oct. 15, 1898, to stockholders of record at the close of business Sept. 30, 1898. Checks will be mailed.

1203-3 EDWARD C. LEE, Treasurer.

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Give experience and reference and salary expected.

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As Superintendent of Gas Works,

By a practical mechanic thoroughly understanding the laying out and erection of plants. Seventeen years' experience as constructor and builder. Best of references.

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I want position as Manager or Assistant Manager of Gas, Electric Light or Street Railway Company in Western city of 30,000 to 100,000 population. Experienced and successful in office and station and with employees and the public. Active and progressive, but sound and conservative. Understand placing these properties in permanent dividend paying condition and keeping them there. Best references.

121,-3 Address "Business," care this Journal.

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Complete Set of Castings for a Coal Gas Retort House of Twenty Benches of Six Retorts to the Bench. Most of it has never been in use. Also,

Two Sets of Flannery Water Gas Apparatus.

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DR. MOSS is open to engage with responsible firm as representative, or charge of works. Will advise on all difficulties met with in the manufacture and distribution of Coal, Oil or Water Gas. Terms reasonable.

Address
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Position Wanted.

A young, active engineer wants the management of a gas property, or a position under an older man at a large works.

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A Small Gas and Electric Light Plant,

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Hydraulic, Dip, Branch and Ascension Pipes, Mouthpieces and Lids, for four Benches of 5's and for one Bench of 3 retorts.

Two Coolers, or Air Condensers, each of 150'000 cubic feet capacity.

Multitubular Condenser, shell, 36 in. diameter, with 98 2-in. tubes, 10 ft. 6 in. long.

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Scrubber, 48 in. diameter, 11 ft. 9 in. high. Three man holes, 11 in. by 15 in.

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1119-tf Dubuque, Iowa.

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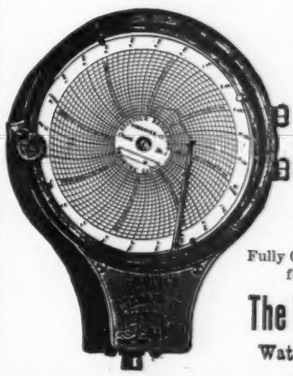

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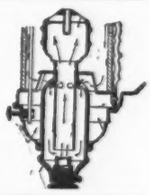

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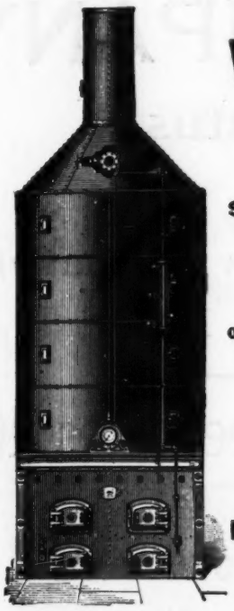

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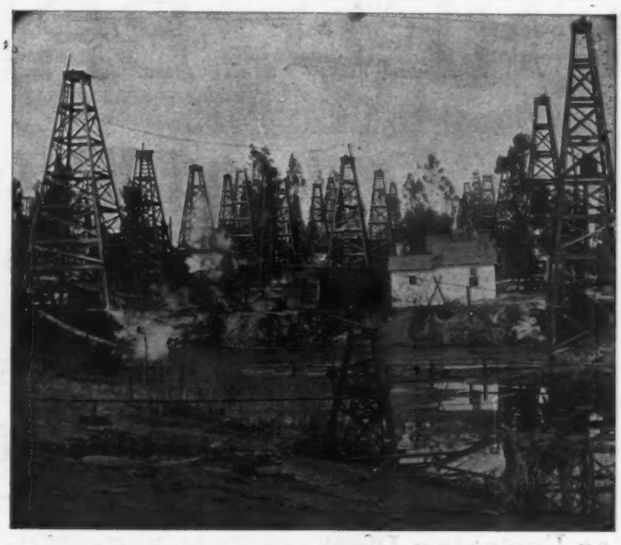

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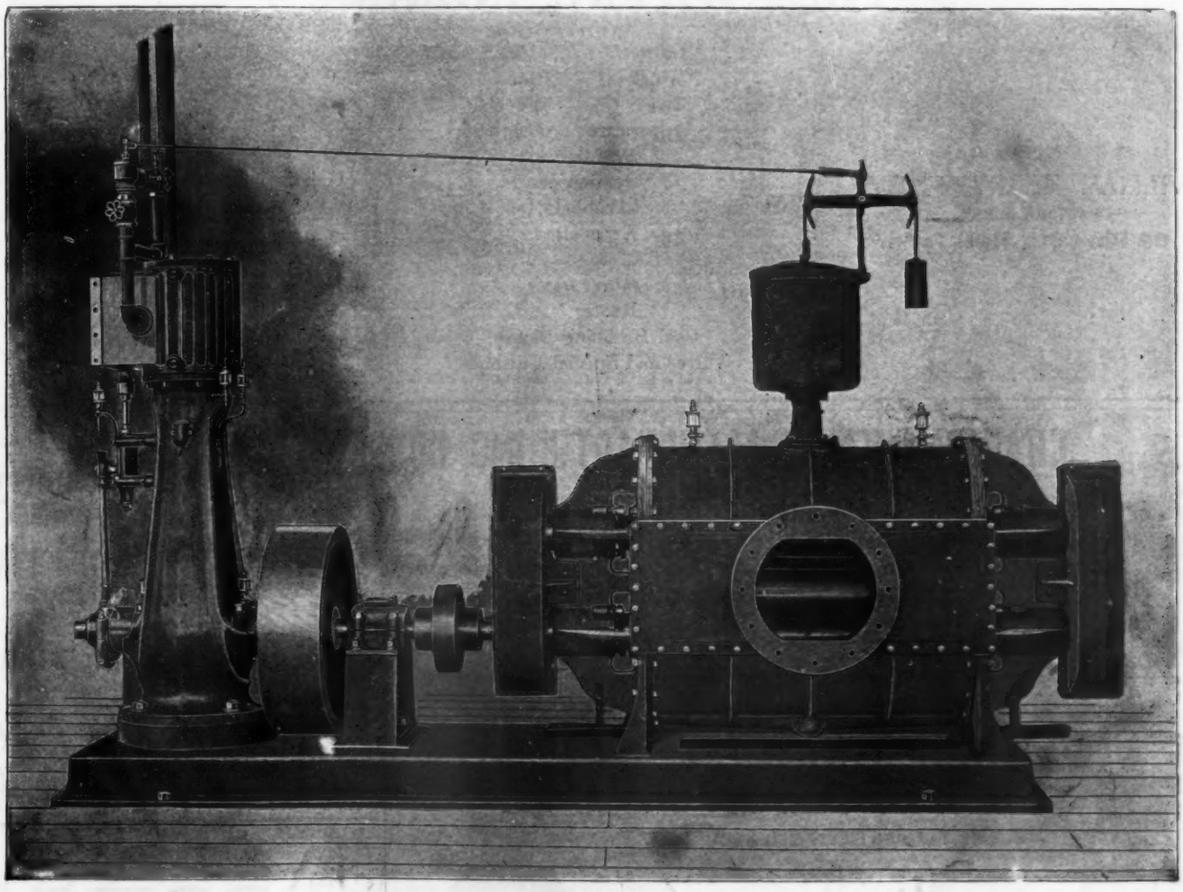

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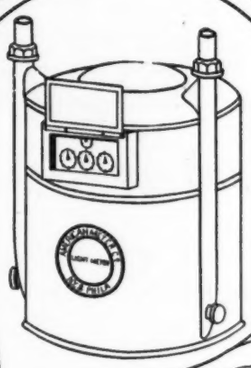
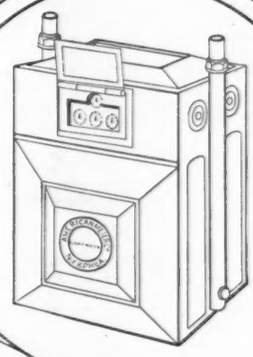
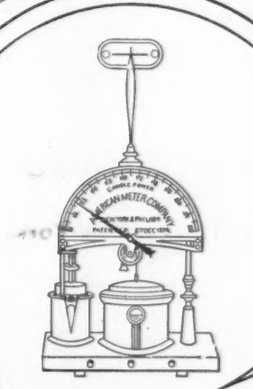


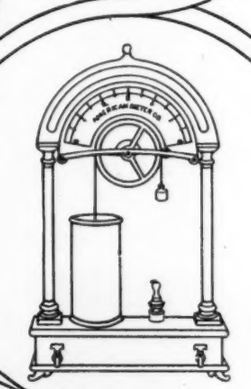


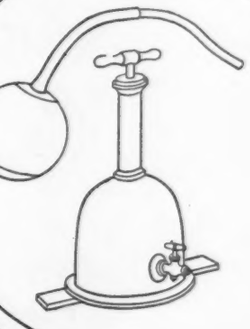
PUBLIC LIGHTING TABLE.

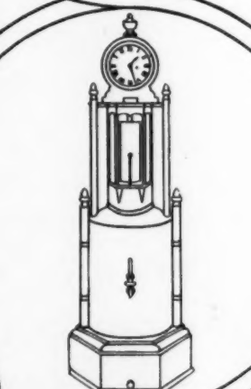
OCTOBER, 1898.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sat.	1	6.10 PM	7.10 PM	5.30	5.00
Sun.	2	6.10	7.50	5.30	5.00
Mon.	3	6.10	8.30	5.30	5.00
Tue.	4	6.10	9.10	5.30	5.00
Wed.	5	6.10	10.00	5.30	5.00
Thu.	6	6.10	11.00	5.30	5.00
Fri.	7	6.10 LQ	12.00	5.30	5.00
Sat.	8	6.10	1.00 AM	5.20	5.10
Sun.	9	6.00	2.00	5.20	5.10
Mon.	10	6.00	3.00	5.20	5.10
Tue.	11	6.00	4.00	5.20	5.10
Wed.	12	6.00	5.10	5.20	5.10
Thu.	13	6.00	5.10	5.20	5.10
Fri.	14	6.00	5.10	5.20	5.10
Sat.	15	6.00 NM	5.10	5.10	5.20
Sun.	16	5.50	5.10	5.10	5.20
Mon.	17	5.50	5.10	5.10	5.20
Tue.	18	5.50	5.10	5.10	5.20
Wed.	19	5.50	5.10	5.10	5.20
Thu.	20	8.20	5.10	5.10	5.20
Fri.	21	9.40 FQ	5.10	5.10	5.20
Sat.	22	10.50	5.10	5.00	5.30
Sun.	23	12.00	5.20	5.00	5.30
Mon.	24	1.10 AM	5.20	5.00	5.30
Tue.	25	2.20	5.20	5.00	5.30
Wed.	26	3.20	5.20	5.00	5.30
Thu.	27	4.30	5.20	5.00	5.30
Fri.	28	No L.	No L.	5.00	5.30
Sat.	29	No L FM	No L.	4.45	5.35
Sun.	30	No L.	No L.	4.45	5.35
Mon.	31	5.30 PM	7.10 PM	4.45	5.35



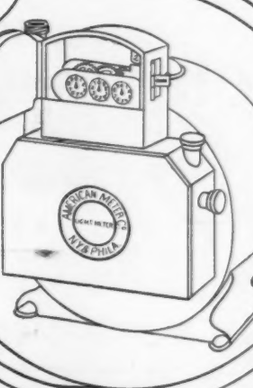


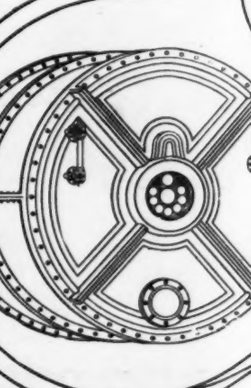




TOTAL HOURS LIGHTING DURING 1898.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	210.40	January	423.20
February	186.40	February	355.25
March	181.20	March	355.35
April	166.10	April	298.50
May	156.40	May	264.50
June	144.30	June	234.25
July	147.30	July	243.45
August	157.10	August	280.25
September	169.50	September	321.15
October	186.00	October	374.30
November	204.30	November	401.40
December	218.30	December	433.45
Total, yr.	2129.30	Total, yr.	3987.45





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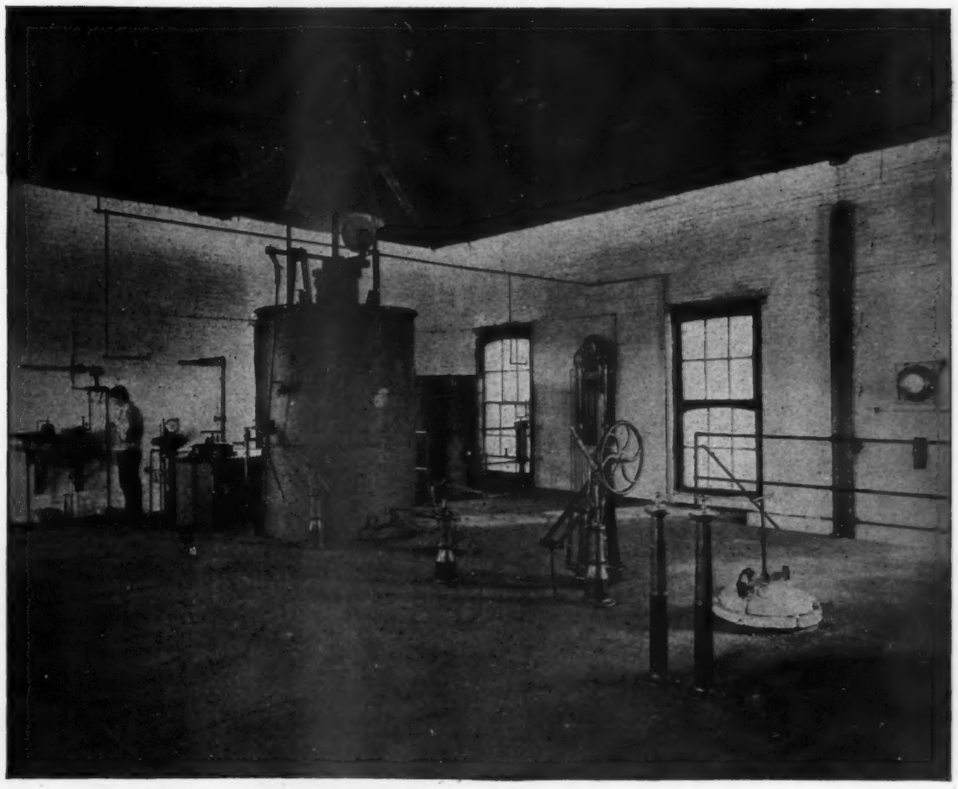

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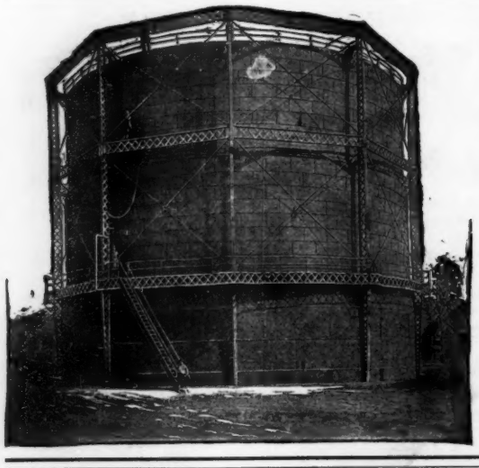

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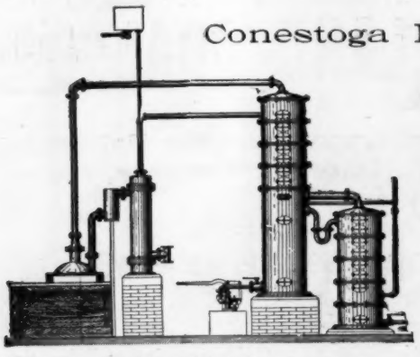

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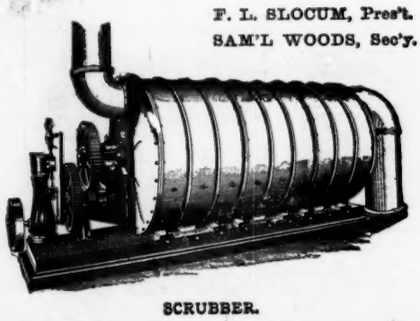

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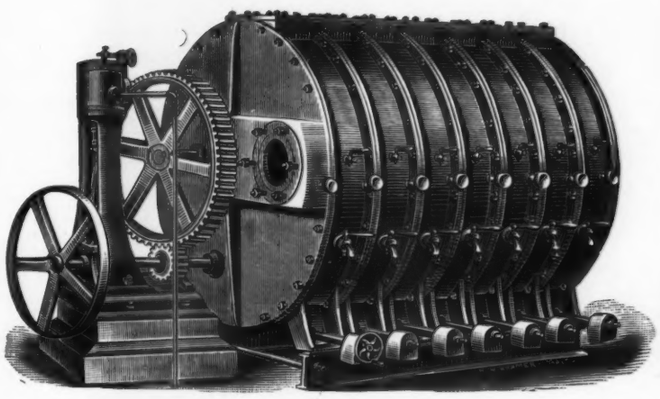

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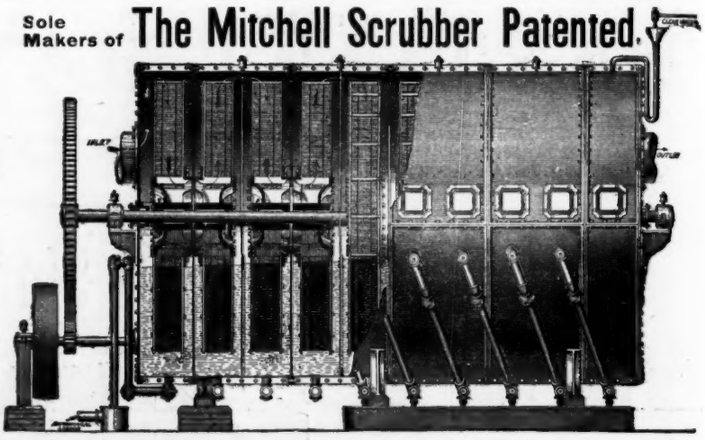

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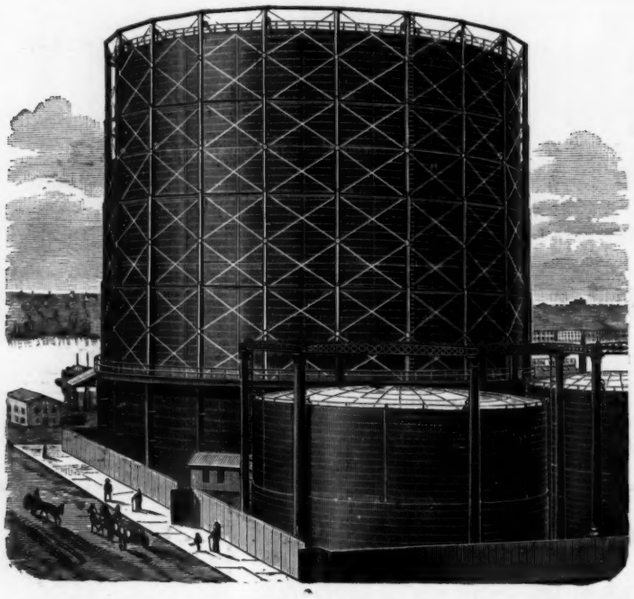

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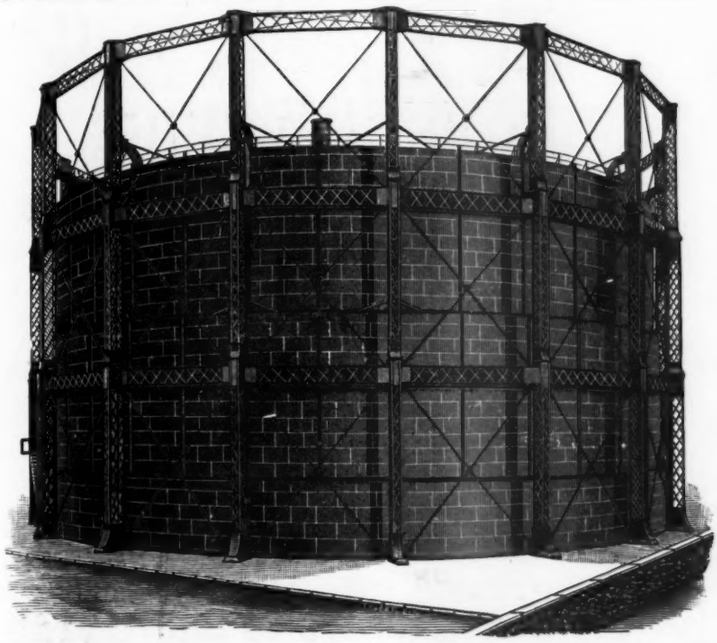

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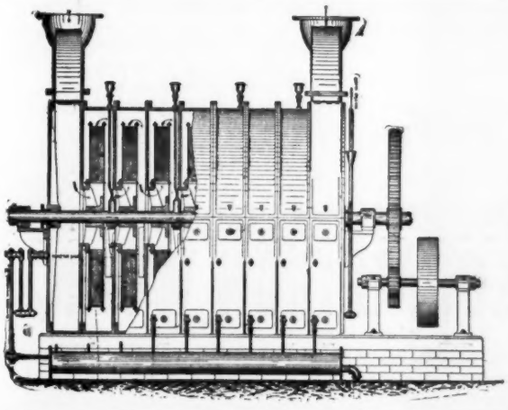

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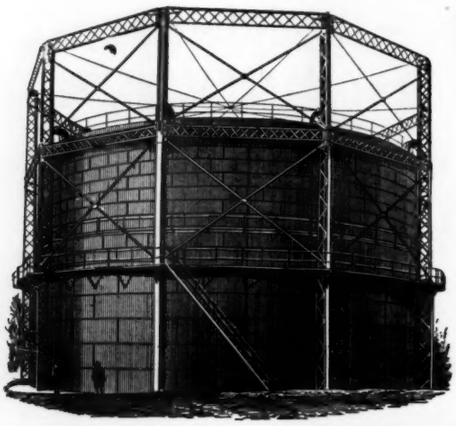

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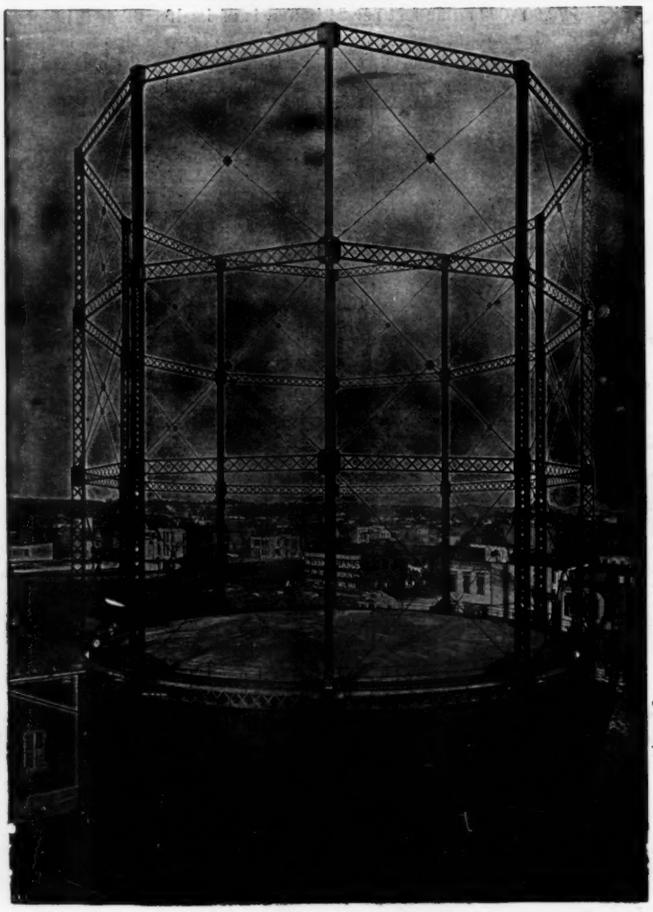

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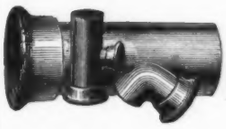

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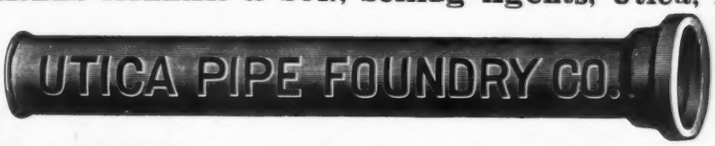

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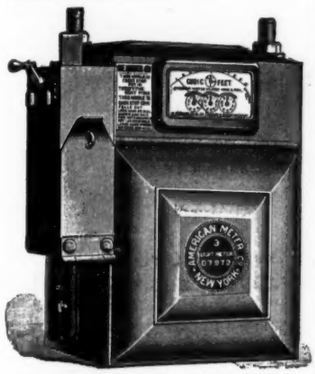

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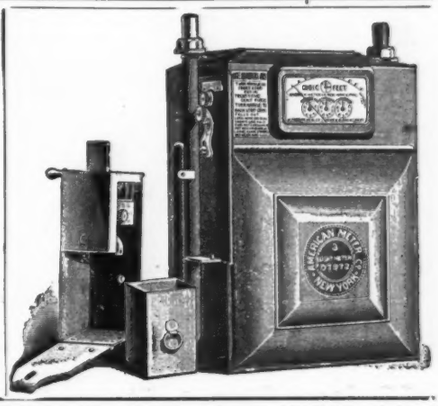

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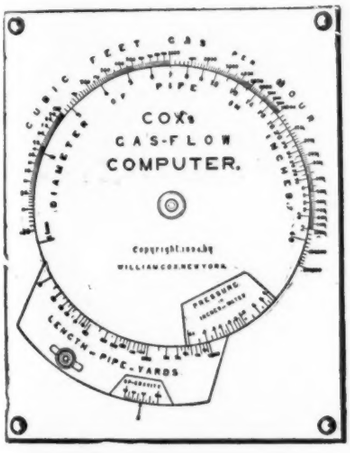

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